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FACTORS AFFECTING THE RETIREMENT OF COMMERCIAL TRANSPORT JET AIRCRAFT

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FOREWORD

This is the second progress report on Factors Affecting the Retirement of Commercial Transport Jet Aircraft, updating an earlier report of late December 1976. A third and, very hopefully, final report is scheduled for December 1978. The initial report, which is included herein, ended with the issuance on December 23, 1976, of the long awaited FAA rule 91-136 which required the retirement or modification of a large portion of the existing commercial transport jet fleet in stages ending in 1985. The industry was stunned by what it perceived to be a broken promise by the government not to enact any such rule unless it was accompanied by financing legislation.

This report adds developments for the year 1977 during which a series of efforts were made to secure financing assistance aimed primarily at providing incentives for retiring existing aircraft. Our analysis highlights how various seemingly small changes in the proposed bills significantly changed the incentives as between retrofit, re-engining and replacement. As a result, had airline executives made equipment decisions during the year based on a bill as it existed at a given point in time, subsequent events could have made the decision a costly mistake. At the end of 1977 a bill did clear the House Committee of Public Works and Transportation. It was then sent to the Ways and Means Committee because the matter involved tax changes.

The third and final progress report will build on the previous reports in two significant areas. First, it will update whatever legislative progress is made in resolving what, if any, financial aid will be enacted which would affect retirement of current aircraft. The previously mentioned Anderson Bill (officially known as the Airport and Aircraft Noise Reduction Act) as approved by the House Committee was acceptable to the airlines, but, as written, not to the House Ways and Means Committee. The number one legislative objective for the Air Transportation Association in 1978 is to recast the House version of the Airport and Aircraft Noise Reduction Act in more acceptable language without losing the benefits. As 1978 begins, the concept seems to be an excise tax with pass-through provisions with the carrier being given credit against its tax liability.

Secondly, the next report will deal more specifically with the interaction of economics and technology between current generation turbojet and turbofan aircraft and derivative or new technology transport jet aircraft as this interaction affects the retirement of the earlier planes.

Of one thing we can be sure: Uncertainty as to government actions on aircraft noise requirements and the financing thereof over the past several years have, in many cases, put a freeze on normal economic retirements.

Frank A. Spencer

February 15, 1978

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FACTORS AFFECTING THE RETIREMENT
OF TRANSPORT JET AIRCRAFT

ABSTRACT

Prejet Era The thousands of aircraft built in World War II and in particular their use in carrying passengers and cargo focused attention of the public on air transportation. Large sums of federal money were fed into the manufacturing industry thus providing financial support to develop more efficient technology for the commercial air transport industry. This technological development, combined with pent-up demand, an increase in disposable income, and an increase in leisure time led to high growth rates in air travel which quickly absorbed the products of the new technology characterized by the more efficient planes. Airlines were able to dispose of their existing aircraft as fast as they acquired new larger craft. Such disposal was above the book value and provided substantial funds for new equipment.

Jet Era The jet age was born in 1958 with the introduction of the Turbojet Boeing 707 and Douglas DC-8. Quickly there followed a period of high growth rates fed by lower fares which in turn were made possible by the lower operating costs of these new technology aircraft. As a result, the industry was enveloped with optimism for the future. Accentuating this optimism was the fact that the new jets immediately began to stretch in size and improve in powerplants. There seemed to be every reason to expect the prejet cycle of retirement and replacement long before useful life expired to repeat itself. On this basis a new series of wide-bodied airplanes were designed and marketed. The first such craft was the jumbo 747. With a capacity of 375 to 500 seats, it represented a quantum jump in seats offered, as compared with existing jets with normal seating of from 100 to 160. The second series wide-bodies were the DC-10 and L1011 which were delivered with 225 to 250 seats in normal configuration. Unanticipated escalation of all categories of costs, a business recession, and the Arab oil embargo, contributed to a dramatic decrease in the rate of travel growth, a swing from profit to loss for many in the airline industry, and the failure of orders of new equipment to materialize.

New Factors Affecting Retirement In the past the factors affecting the retirement of aircraft have been very similar to those affecting the replacement of machines in industry generally. Roughly they include: (1) the need to replace because machines are worn out or economically obsolete, (2) the ability to finance replacement,

(3) the availability of a more efficient substitute of the correct size and market appeal, and (4) the availability of a substitute which has lower operating costs, including the costs of ownership, than the existing machine. However, in the current airline equipment retirement situation, four entirely new factors have emerged which have added further uncertainty for the decision makers, not only in the airlines but in the airframe and engine manufacturing companies as well. These factors are:

(1) "Deregulation" or "Regulatory Reform"

(2) Aircraft noise regulations and the financing of compliance

(3) Availability and price of jet fuel

(4) Inflation to the degree that costs may offset technological efficiencies

With regard to "deregulation" or "regulatory reform" this study concludes true deregulation is not a real threat. Therefore, the initial position taken by the industry that "chaos" is around the corner is not valid. Similarly, although there is still considerable rhetoric emanating from some industry quarters to the effect that the U.S. has the best air transport system so let's not change the regulatory system, it is perceived that, in general, the industry recognizes the inevitability of a change, and will work for some sort of legislation along the lines of a Kennedy-Cannon or Levitas bill. Finally, CAB action under the new aggressive Chairman Alfred E. Kahn has convinced many carrier executives that change is at hand either with or without reform legislation. Therefore, it is concluded that while the uncertainty of regulatory reform legislation is not helpful to the decision makers, in fact managements are not holding up equipment plans for this reason.

The second new factor is the noise controversy. In 1974, the FAA proposed an amendment to FAR 36 requiring all existing jet aircraft to meet new stricter noise emission standards which over 80% of the jet fleets do not now meet. A segment of the population living near airports have asserted a loss in property values, a deterioration in the quality of life and adverse effects on the education of their children - all due to jet noise. Buttressed by favorable court decisions airport neighbors have pressed for more stringent federal rules. Late in 1976 the FAA adopted the proposed amendment with a near term cost estimate of between one and five billion dollars.

The opponents of the rule argue that installation of retrofit kits of sound absorbent material would not make a perceptible difference for the current non-FAR 36 planes with the JT8D engine. They also argue that while application of SAM to the 707 and DC-8 series with JT3D powerplants would provide significant relief on approach, modification is not warranted because: (a) the greater problem is on takeoff where there is little benefit, and (b) more importantly, because the planes are not only old and approaching the end of their design life but are also extremely fuel inefficient. Therefore, these latter craft are almost, if not already, economically obsolete. Finally, it is clear that the expenditures of large sums on retrofit will decrease funds available for purchasing new aircraft which themselves will reduce noise to a greater degree and will also use less of a scarce resource - petroleum. Prior to November 18, 1976, the evidence is that the FAA had no intention of promulgating new noise rules absent a legislative plan to assist in the financing. The November 18th Aviation Noise Abatement Policy statement was a reversal of this position.

Just before leaving office President Ford reversed administration policy and proposed legislation to assist in financing. Throughout 1977 there were a series of bills purportedly aimed at replacement. However, the emphasis, in fact, varied between retrofit, replacing engines, and replacing the airplane. After considerable political maneuvering a bill known as H.R. 8729, Airport and Aircraft Noise Reduction Act, was reported out of the House Committee on Public Works and Transportation on December 13, 1977. This bill emphasized replacement and currently is the number one priority item of the Air Transport Association for legislative action in 1978.

In sum, the controversy over the desirability of retrofit versus re-engining or replacement, plus the uncertainty of who will bear the cost, has, and continues to muddy the decision process on retirement of existing aircraft. The provisions of a financing bill can markedly affect not only the timing but also the direction of retrofit, re-engine, or replacement.

The third new factor relating to the replacement of current jets is availability and price of jet fuel. Short run availability became an issue at the time of the oil embargo and present energy forecasts indicate increasing shortages shortly after the turn of the century. Presently availability is not a factor in the minds of those making equipment decisions. However, price is. The price of jet fuel has more than tripled from about 11¢ per gallon to over 38¢ domestically with a general agreement that escalation will continue. International fuel costs are higher. The rise has done much to render certain aircraft models economically obsolete. While new or derivative technology aircraft are significantly more fuel-efficient than the narrow-bodies, a difficulty arises in optimizing fuel costs unless a stable price is known. NASA and

industry studies indicate that aircraft designs are different for 10¢, 30¢ and 60¢ fuel. Designers have been successful in reducing specific fuel consumption from early jets by about one third.

The fourth factor affecting the retirement of aircraft is inflation. In the 60's, with a stable price level, the increasing profitability of new more efficient aircraft, together with cash flow from depreciation, enabled carriers to finance equipment purchases. Currently year-to-year price increases for the same equipment are running 8 to 9%. Finally, the rising cost of the technology can offset the increased efficiency to the point that carriers see no financial advantage to replacing their current aircraft.

Age As a Factor: Age was examined in the context of chronological age, age in hours of service, age in cycles (landings or pressurization) with the conclusion that none of these are critical in the retirement problem.

End of Book Life: The investigation revealed that there has been considerable variance in rates of depreciation charges. The variance is due primarily to "financial management" policies and hence has no necessary direct relationship to actual retirement policies on aircraft.

Financial Perspectives: The financial capabilities of the airlines in general and more particularly of the airlines who historically have been leaders in the reequipment cycle were, in the 1970-1975 period, such as to pose extremely serious problems in raising funds for launching a new technology or derivative airplane. As a result of high debt/equity ratios and poor earnings records, long term financing by insurance companies had become an unlikely event. In 1976 there were a limited number of what may be described as interim aircraft equipment purchases financed by commerical banks, manufacturers, and other lenders under imaginative contractual procedures. With new technology or derivative aircraft estimated to cost from $20 to $30 million each in the 200 seat category and with the quantities needed for individual airlines, lending institutions could not justify financing for some needy airlines.

It should be pointed out that the very lines which had launched the jet era are the ones with the largest fleets of old noisy fuel-inefficient aircraft. The return on investment of TWA, PAA, American and United over recent years has been such that equity investors can find other investments of much less risk. United with over $550 million in cash and short-term securities was currently stronger than any of the others mentioned above. However, with a commitment of over $500 million for 46 727-200 series and not one new type on order the question of how to finance a need of $6 billion is not easily answered.

The year 1977 showed a resurgence of profitability. Balance sheets evidenced considerable "corrections." At least one carrier, though not a candidate for launching new large scale equipment purchases, obtained a long term unsecured financing from insurance companies. Notwithstanding these favorable developments, one must consider that a significant portion of the earnings and balance sheet corrections came from accounting adjustments which cannot continue without limit. There are bullish and bearish airline financial forecasts for the future. Consistently strong operating earnings are not yet in sight.

Conclusion: An examination of the technological advances recently made and in prospect lead to the conclusion that each unit of technology has become more and more expensive to the point where costs have offset economic benefits. No quantum jump such as occurred when the jets were introduced or when the more efficient fanjets were developed seems in prospect. To provide adequate return for investors such that capital can be attracted, higher fares may be necessary as costs escalate further. This implies a slower growth rate than many have projected. An alternate solution under current experimentation is imaginative promotional fares carefully tailored to avoid diversion and at rates above marginal costs. This further suggests the importance of focusing research in the area of cost reduction rather than in performance and the amenities of flight.

FACTORS AFFECTING THE RETIREMENT OF TRANSPORT JET AIRCRAFT

A. INTRODUCTION

A.1 RESEARCH TASK

In June 1975 representatives of airlines, aircraft manufacturers, the investment community, the government, and academia met in Washington under the sponsorship of NASA for an Air Transportation Demand and Systems Analysis Workshop. Various participants pointed out that because historically there had been a relationship between the demand for air travel and the type of equipment and service offered, there was a need to know more about retirement plans for current aircraft. Both the engine manufacturers and the aircraft manufacturers suggested an investigation into what elements went into the retirement decisions of management. The airline representatives themselves expressed interest in further studies of the length of life of existing jets and the possibilities and costs of extending this life. Both the airlines and the manufacturers were concerned about new factors entering the replacement equation, such as (a) noise regulations, (b) fuel prices and fuel availability and (c) inflation. Finally, the lending institutions who had a large stake in financing previous airline equipment as well as financing the large aircraft manufacturers and their suppliers were interested in what type of commitments would be sought by their customers. At that time, when a number of major airlines were in serious

difficulties, figures in the area, depending on the time span considered, of from 20 to 60 billion dollars were mentioned.

As an outgrowth of the concerns and questions raised, the current study was sponsored by NASA to investigate the technological and economic factors affecting the retirement dates of commercial jet aircraft. As time went on it became necessary to add to the area of investigation the effect of legislation and environmental forces. It was hoped that perhaps some specific predictions could quantify retirement dates.

A.2 RESEARCH PROCEDURE AND FOCUS

Early research satisfied us that because of varying dynamic forces a meaningful mechanistic model is not possible. As the text will demonstrate, there is no reason to retire current jets in the next several years because of chronological age, hours of service, number of cycles (whether they be landings or pressurization cycles). Therefore, retirement decisions are economic, or even political, on various perceptions of future demand and costs flavored by voluntary or involuntary induced ideas as to timing of replacements or environmental reasons. These decisions are the results of interreaction between the engineering departments of the airlines and manufacturers as well as fleet planners and the high echelon corporate officials who deal not only with market factors, plane economics, and financing but also with regulatory authorities.

Therefore the research procedure determined upon was field trips to the headquarters of the three major aircraft manufacturers, the two primary engine manufacturers, most of the major trunk airlines, the

FAA, DOT, ATA, CAB and lending officials of Insurance Companies, Commercial Banks, and Institutional Lenders. Additionally, investment analysts and members of the staff of the Subcommittee on Aviation of the House Committee on the Public Works and Transportation were consulted.

To provide an underpinning for the study as well as to develop the broad dimensions of the problem a complete inventory of the free world commercial jet fleet, focused on various parameters of age, was developed covering 1958 thru 1975. (Appendixes A and B) This large data base includes categorization by airline, by equipment type, age in year, age in hours, and cycles of high time aircraft as well as whether the aircraft were purchased new from the manufacturer, or purchased used.

Generally speaking the interviews with the aircraft manufacturers encompassed several visits of more than one day each. Interviews with airlines ranged from several hours to several days. A sample list of questions and issues discussed is found in Appendix C. A partial list of the companies and agencies visited and persons consulted is found in Appendix D.

A.3 REPORT STRUCTURE

The report is structured to present first a brief historical background of the technology and economics of aircraft replacement and retirement in the prejet era to see whether useful insights can be obtained applicable to the jet area. As the text demonstrates there are very significant differences between the two periods with several entirely new factors being present currently. These new factors are

identified and explored. Secondly, the report proceeds with an investigation of current technological and operational economic perspectives. Decisions are made by humans not by computers and hence it is the interpretation of technological and economic data against certain past experiences, prejudices and attitudes that result in ultimate equipment decisions. Therefore, in the body of the report there is an attempt to flavor the pure technical and economic factors with the qualifications put upon them by the corporate decision makers.

The final main section of the report deals with the financial perspectives. To be sure, this is an economic element. However, because of the adverse financial results for many of the carriers in the early 1970's the financial perspectives emerged as a focal point in our investigations. Therefore, a separate section is necessary for its treatment.

To complete the report some conclusions are drawn as to aircraft retirement policies. These are followed by observations on future research needs.

B.

THE SETTING: THE AIRLINES AND AEROSPACE THEN AND NOW

B.1 THE PREJET ERA, 1934 - 1958

A brief survey of the prejet era was made seeking clues which would be helpful as to factors affecting current retirements. In 1934 Commission type regulation of the airlines began under the ICC. Thus this period is the first in which public records are available. At that time there were 56 different aircraft models built by 21 different manufacturers. By today's standards capital costs were amazingly low. Some models cost from $30,000 to $50,000 with the first DC-2 being considered expensive at $73,000. Carriers depreciated aircraft to zero in one to three years. Some used depreciation based upon hours using a life of from 1,500 to 6,000 hours. By 1938, a 5-year depreciation was considered standard for the DC-3. As time went on service life of the DC-3 which between 1936 and 1941 sold for from $90,000 to $100,000 was computed for depreciation purposes at 7 years.[1/] Airlines were indeed an infant industry struggling with subsidies to stay afloat.

The post World War II period of prejet operation from 1946 to 1958 was one of rapid growth. Traffic growth made larger size more practical, and the larger size was accompanied by lower operating costs which in turn, as a result of decreased fares, developed further growth. Among the reasons for this rapid growth were an increase in GNP, an increase in disposable income, an increase in leisure time,

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1/ Spencer, F.A. Air Mail Payment and the Government, Washington, D.C., 1941, The Brookings Institution. Chapter IX.

an increase in the frequency of airline service and a declining fare level. Not to be overlooked was the development of the pressurized, 4-engined long-range faster transport which combined increased comfort with a more efficient use of leisure time.

From 1946 on there were incremental technological advances involving, with one or two well known exceptions, superior economics which served as an incentive to carriers to replace portions of their fleets. A further contributing factor was the price of used aircraft during this period. An examination of capital costs of new aircraft versus used aircraft prices is found in Gellman's study.2/ While certain prices did fluctuate widely, in general it was a period in which significant amounts of capital could be secured from the used aircraft to apply to the purchase of new. Although there was an escalation of prices for new aircraft, it was not the quantum price jump relationship which exists in the 1975-1978 period. The following table for the prejet era lists several examples of the cost as new and selling price as used aircraft.

2/ The replacement of various commercial piston aircraft with new (and sometimes the same) types and the reasons therefore are treated more extensively in Gellman, A.J. Effect of Regulation on Aircraft Choice, Cambridge, Mass. 1968. MIT Ph.D. thesis.

TABLE 1

SOME PREJET NEW AND USED PRICES

Model No.	Year Purchased	Price	Year of Sale	Selling Price
L-049	1946	$ 800,000	1956	$ 900,000
L-749			1953	800,000
DC-4		400,000	1951	355,000
			1952	700,000
			1956	700,000
DC-6B	1951	1,000,000	1954	1,400,000
DC-6	1946-53	600,000	1953	1,600,000
		800,000		
DC-7	1953-55	1,700,000	1957	2,100,000
			1962	100,000
DC-7B	1953-55	1,900,000	1962	100,000
DC-7C	1956	2,200,000	1962	350,000
L-1649	1957	2,300,000	1962	150,000
CV-240	1948	225,000	1950	337,000
			1952	540,000
CV-440	1956	650,000	1958	650,000
B-377	1949	1,500,000	1960	Scrap

The economic environment in which the carriers and manufacturers find themselves today is quite different from that of the 1946-1958 prejet era. However, Table 1 above, integrated with the history of carrier actions with regard to developing markets under the regulatory regime of the Civil Aeronautics Act of 1938 and its successor the Federal Aviation Act of 1958, sheds some light on factors affecting the retirement of aircraft in general. First, the table indicates that in periods of substantial traffic growth airplanes with "good economics" not only hold their value but may increase in value. DC-4's which cost $400,000 were sold several years later for $800,000. DC-6's also were successful in the used market. In the mad scramble to acquire new airplanes to accommodate compound traffic growth there were cases in which carriers which had ordered a block of airplanes

and had positions on the production line sold aircraft at a profit to others before ever taking delivery.

The precipitous decline in the price of the DC-7 is explained as follows. While earlier series of planes each had lower operating costs than their predecessors and hence at normal load factors were more profitable, the DC-7 series was the result of individual carriers attempting to beat the competition in coast-to-coast nonstop operation. It was, or should have been, quite clear to the purchasers that the seat-mile costs of the DC-7 would be higher than on existing aircraft. However, it was reasoned that inasmuch as the competitor did not have the speed or nonstop capability of the DC-7, a carrier with a DC-7 would develop a monopoly and be able to maintain a sufficiently higher load factor to be profitable while awaiting the arrival of the new jets. In other words, the DC-7 was an interim airplane. The theory worked in practice for a while but eventually others purchased the DC-7 or a substitute plane and the uneconomic aspects of the DC-7 operation became a reality. As a result the used price fell.

One thing the DC-7 did demonstrate clearly was that the public, aided by advertising from airline marketing departments, can be led to believe for a time that a new type of plane is the desirable one on which to ride. Gellman reported several cases in which a carrier on receiving a new route could have instituted service with a more efficient DC-6B, but chose to wait and publicize the newer faster (and noisier) DC-7. Using this technique, Continental was successful in developing market dominance on the Denver-Los Angeles route,

Braniff on the Los Angeles-Dallas route, and American on the New York-Los Angeles route.

Gellman, after examining used aircraft sales for most of the prejet period, concluded that airlines sold their aircraft 7 to 10 years after purchase and generally at or above book value.

B.2 THE JET ERA, 1958-1976

(a) Narrow-Bodies: Introduction of the long range narrow-bodied jets, namely, the 707 and DC-8 series, began with 8 deliveries in 1958. In 1959 the figure rose to 98. With the addition of the Convair line in 1960, deliveries rose to 195. Table 2 provides a complete rundown for the free world of deliveries by years and by type from 1958 to 1975 of all domestically produced jet aircraft. The number of those still in commercial service at the end of 1975 are listed below.

Number of Jet Transports in Service Dec. 1975

Boeing	
707 & 720	724
727	1,130
737	407
*747	243
Douglas	
DC-8	463
DC-9	687
*DC-10	211
Convair	
880 & 990	17
Lockheed	
*L-1011	118
	4,000

*Wide-Bodies

Table 2
Free World Active Jet Aircraft Fleet
Total Production By Year of Original Delivery
U.S. Manufacturers 1958-Year End 1975

	Boeing				Douglas			Convair	Lockheed	
Year	707 & 720	727	737	747	DC-8	DC-9	DC-10	880 & 990	L-1011	Total
1958	8									8
1959	77				21					98
1960	91				89			15		195
1961	80				44			27		151
1962	68				22			30		120
1963	34	6			19			19		78
1964	38	95			20			9		162
1965	62	111			31	5		2		211
1966	182	135			32	69				318
1967	118	155	4		41	158				476
1968	111	160	107		102	202				682
1969	59	115	112	4	85	122				497
1970	19	54	36	92	33	49				283
1971	10	33	30	69	13	46	13			214
1972	6	41	22	30	4	32	52			187
1973	11	92	23	30	-	29	57		56	298
1974	21	91	55	22	-	48	47		41	325
1975	9	91	51	21	-	42	45		25	284
Total	904	1,179	440	268	556	802	214	102	122	4,587
*1976	2	61	41	29	0	47	19	0	16	215
*1977	5	67	25	20	0	22	15	0	11	165
Total	911	1,307	506	317	589	894	247	102	149	4,967
Active in Airline Service(1975)	724	1,130	407	243	463	687	211	17	118	4,000

Source: "Ross, Commercial Jet Replacement Process", MST Thesis. Transportation Center, Northwestern Univ.

*Update from manufacturers

It is to the factors affecting the retirement of these aircraft that study is addressed. Appendix A contains a breakdown by carrier (trunks, regional/local service and supplemental/cargo) for the United States. The breakdown includes the number in service, the first year operated, whether any in the fleet were purchased new, the age of the oldest planes of the type, the highest hour plane and the highest cycle (landing) plane. Table 2 indicates that of the 4,000 in service in 1975 3,428 were narrow-bodies.

The early 1958-1959 707's and DC-8's "flyaway"[3/] cost was in the neighborhood of $4.8 million each. By 1969 the craft had been "stretched" and new models were priced as high as $10.2 million for the largest versions. Deliveries of the 727-100 series began in 1969 "flyaway" at $5.8 million. By 1976 the price escalated to $11.0. The early Boeing 737 series entered the books at about $3,400,000 in 1969. A 1976 new purchase was reported as $6 million, and American Aviation Daily 9/23/76 reported a sale for 1977 delivery at $7.5 million.

(b) Wide-Bodies: The same type of price escalation has occurred on the wide-bodies. The early 747-100 series were sold for $21.9 million each with the freighters running about $5 million more. By 1976 prices had risen to about $35 million for the regular 747 with a recent announcement of a 747 combination passenger/cargo aircraft for 1977 delivery at $45 million. A 1978 delivery purchase has been reported as $54 million. Lumping the DC-10 and the L-1011

3/ "Flyaway" means airframe, furnishings, avionics and engines.

together we find 1972 and 1973 introductory prices of around $17 million. Since that time prices have moved upward to the $22 million area for the lower priced models and $30 million for the higher. The first order for the new long range version L-1011-500 was reported as $37 million each.

The above figures, dealing as they do with a general model and not with specific series of each model, are misleading to the extent they mask the increase in the number of seats and changes in range and missions of the specific series. However, the above figures may be generalized by referring to the U.S. Department of Commerce, National Income and Wealth Division, Bureau of Economic Analysis table of the relative increases in new aircraft prices on the basis of the "GNP Deflator" which shows index numbers indicating a 22% rise between 1956-1967, a 12-year period, followed by a 20% rise in the next 5 years to 1972. Escalation has proceeded at a faster pace since that time and, according to the Department of Commerce, rose another 41% in the next 3 years to 1975. Our talks with potential customers indicate their perceptions are for an increase of 8 to 9% compounded annually for the near term.

To summarize, the jet era began at a time of surging demand and adequate profits. Further, it was initiated by planes requiring unit capital expenses of about $4.5 million for the 707 and DC-8. The first Fanjet 707-300 series began in 1962 at $6 million. Price escalation increased the price to $10 million in 1972 and to $15 million in 1976. These aircraft are now no longer produced for domestic use because of high fuel consumption and their failure

to meet federal government's noise regulations for current production aircraft. In the middle 60's the intermediate range 727 initially sold at $4.5 million and, after being stretched in length in the 200 series have now escalated in price to about $11.5 million each. The shorter range 737 and DC-9 deliveries began in 1968 with a price tag of $3.4 million and by 1976 had about doubled in price. The larger DC-10, L-1011 and 747 have, in a shorter time, experienced similar increases to the point where commitments made in 1976 will result in capital outlays of $25-35 million for each of the smaller wide-bodies to $45 to $55 million for the jumbo 747 combination passenger/cargo version. In a period of no or small growth, or in a period of some excess capacity and particularly in a period of unsatisfactory capital formation, this substantial increase in the "lumpiness" of capital has a dampening effect on retirement of current jets. In a period of excess capacity additional units can be supplied by aircraft carried on the books at low or zero value instead of expending $12 million to $40 million per unit. Unless the carriers see a replacement aircraft with significant economies (including ownership costs) or which can be used as a product differentiation marketing factor, the incentive for retirement is limited. Government mandated noise regulations, as will be seen in another section, can significantly affect management's equipment plans.

CURRENT POLICY CONCERNS

Generally speaking, retirement of one aircraft for another depends upon finding a "better mousetrap." Translated into economic terms this means finding a replacement which is the correct size for the mission, which has lower operating costs including ownership costs, and which has attractive features to sell to the passengers, i.e. revenue generating possibilities. Of course, additionally the availability of capital at a satisfactory price must be present. However, at the present time three other factors have surfaced which have been alleged to affect the investment decision even if the other factors were satisfactory. They are (1) the spectre of "de-regulation" or "regulatory reform," (2) government policies on aircraft noise control, and (3) the existence or non-existence of, as well as the tilt of, special legislative financial assistance or incentives for retirement provided by Congress.

C.1 DEREGULATION OR REGULATORY REFORM

For several years a segment of the academic community has argued that because of the economic characteristics of airlines the type of regulation provided by the Civil Aeronautics Act of 1938 as amended by the Federal Aviaition Act of 1958 has resulted in the protection of inefficient carriers, competition in service, and higher than necessary fares to the detriment of the public. The story has been detailed extensively in the literature in recent years.4/

4/ Richard E. Caves, Air Transport and Its Regulators: An Industry Study, Harvard University Press, Cambridge, 1962. Lawrence J. White,

On October 8, 1975, President Ford announced a legislative reform program encompassed by a bill known as the Federal Aviation Act of 1975. This bill if enacted would have been a major policy change in regulating the airlines. The Act, among other things, would make pricing more flexible, provide for a much freer system of entry and exit, relax rules on mergers and consolidations, and remove constraints from Supplemental carriers. The announcement of this proposed legislation triggered an avalanche of hearings,5/

"Quality, Competition and Regulation: Evidence from the Airline Industry," in Regulating the Product: Quality and Variety, Richard E. Caves and Marc J. Roberts, eds., Ballinger, Cambridge, 1975. George W. Douglas and James C. Miller III, Economic Regulation of Domestic Air Transport: Theory and Policy, The Brookings Institution, Washington, D.C., 1974. George C. Eads, The Local Service Airline Experiment, The Brookings Institution, Washington, D.C., 1972. Richard E. Caves and Elisha Pazner, "Value of Options, Value of Time and Local Airline Subsidy" in Regulating the Product: Quality and Variety, Richard E. Caves and Marc J. Roberts, eds., Ballinger, Cambridge, 1975.

George C. Eads, "Competition in the Domestic Trunk Airline Industry: Too Much or Too Little?" in Promoting Competition in Regulated Markets, Almarin Phillips, editor, The Brookings Institution, Washington, D.C., 1975. Sidney L. Carroll, "The Market for Commercial Airliners," in Regulating the Product: Quality and Variety, Richard E. Caves and Marc J. Roberts, eds., Ballinger, Cambridge, 1975. William A Jordan, Airline Regulation in America: Effects and Imperfections, Johns Hopkins Press, Baltimore 1970. George W. Douglas and James C. Miller III, Economic Regulation of Domestic Air Transport: Theory and Policy, The Brookings Institution, Washington, D.C., 1974.

5/ U.S. Congress, Senate Subcommittee on Aviation, Regulatory Reform in Air Transportation, Hearings before Subcommittee on Aviation of Committee on Commerce. 94th Cong. 2nd Session, Apr., 1976, 1314 pp.

proposals, seminars and workshops throughout the country.[6/] Subsequently other proposals and bills were drafted such as the Kennedy bill, the Bureau of Operating Rights of the CAB proposal, the CAB proposal, the Anderson-Snyder bill, and bills carrying Senator Cannon's and Rep. Levitas's names. Despite numerous hearings and pressure by both the Ford and Carter administrations, none have as yet (February 1978) been adopted by the Congress. However, the financial condition of the airlines which some attribute to faulty regulatory legislation, plus complaints by the "have not" airlines, plus a heavy thrust by the Department of Transportation lead to the conclusion that there will very likely be substantial changes liberalizing the provisions of the Civil Aeronautics Act of 1938 as amended by the Federal Aviation Act of 1958. Even if such legislation does not pass, public pressure plus new members of the Civil Board who have different philosophies than the old indicate that, under the CAB, there will be a large measure of de facto regulatory change. Under Chairman Kahn this is well under way.

The initial reaction of the airlines and the financial community to the bills, particularly the original DOT bill, was negative to the point of predicting chaos and bankruptcy. Publicly the airlines and the financial community maintained that the prospect of any such legislation increased the risk of doing business so much that all thoughts

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6/ Regulatory Reform and the Federal Aviation Act of 1975, A Workshop held at the Transportation Center, Northwestern University, Evanston, Ill., Feb. 29 and March 1, 1976. Sponsored by Northwestern and the Program of University Research of the Department of Transportation.

of purchasing replacement equipment were put aside. Until the fear of "deregulation" or "regulatory reform" had disappeared the airlines could not consider replacing aircraft, and if they did, the financial community would not loan the funds for new equipment. The strategy of the airlines that could afford to consider new equipment was to husband their cash to be ready to outlast the weaker airlines when freer entry became effective. Some airlines would survive, would then be monopolists and recoup their fortunes.

Our interviews with airline managements, aircraft and engine manufacturers, and the financial community began in June 1976. By this time there had not been much change in the rhetoric, publicly, but privately we discerned a growing feeling that some change, though substantially different from the DOT bill, would not only be forthcoming but actually could be beneficial. At the present time, the industry,with some striking exceptions, seems ready for less restrictive legislation. Our most recent surveys lead us to conclude that the horror with which regulatory change was first approached has dissipated. When we investigate the factors involving the retirement of current aircraft, the fear of regulatory change is not a significant factor impeding their retirement.

C.2 NOISE CONTROL AS FACTOR IN RETIREMENT DETERMINATIONS

This subsection deals with the environmental concerns of aircraft noise control and concludes that changes not only in the federal government's FAR 36 noise regulations, but also in airport and municipal regulations dealing with sound emissions have both a positive and negative effect in the minds of airline managements

making judgments on whether to retire old jet aircraft. Whereas promulgation of noise rules makes management focus attention on retirement, the uncertainty of government policy has tended to delay decision making for retirement, particularly where financing was also a problem. To put the situation in proper perspective a summary of the history and present state of the noise regulation is in order.

(a) History of the problem and attempts to deal with it. The first jets introduced were the Boeing 707 and Douglas DC-8 powered by very noisy JT3 and JT4 turbojet engines. Shortly thereafter, a somewhat quieter and much more fuel efficient engine, the JT3D low-bypass turbo fan, was introduced. Some carriers immediately re-equipped their fleets with this power plant and the JT3D shortly became standard on all new production aircraft. However, these craft were still objectionably noisy and the affected public pressed for relief in various ways at various levels of government. Pressure was also applied to private airport owners.

In 1966 President Johnson asked his Office of Science and Technology to develop a noise abatement and sonic boom program. The new DOT Act of 1966 established an Office of Noise Abatement but did not provide regulatory authority for noise control. Legislative authority to regulate noise was given to the FAA in 1968 by an amendment to the Federal Aviation Act of 1958, in Section 611. The authority was not unlimited but was subject to (1) safety considerations, (2) the economics of reasonableness, (3) the requirements of being technically practical and (4) the requirement being appropriate for the type of aircraft to which it would be applied.

1969 saw the FAA promulgate FAR 36 as the basic noise control regulation.[7] Its thrust was aimed not at the then current fleet of jet aircraft but at future design aircraft. The new wide-bodied 747, DC-10 and L-1011 jets come under and meet this rule. Early 747's did not. The rule (App. E) limited sound emissions measured at three points: (1) take off, (2) approach, and (3) side line. To describe the type of sound being regulated a unit known as EPNdB (Effective Perceived Noise in decibels) was employed. Whether this or some other unit should be used in certain situations has been the source of endless debate and much confusion. Various versions of bills introduced in 1977 addressed this point in particular. Additionally, heavier transport jet planes were permitted higher EPNdB than lighter ones. This, too, has been a source of controversy.

The preamble of FAR 36 in 1969 put the aviation industry on notice that the FAA in the future planned to regulate the noise levels of the then current 707, 727 and DC-8 jet fleet under its congressional mandate to provide present as well as future noise relief. Public pressure continued and Congress in its 1972 Noise Control Act amended Section 611 in an attempt to hasten FAA action by declaring it to be the policy of the United States "to promote an environment for all Americans free from noise that jeopardizes their health or welfare." Federal agencies were directed to carry out the programs within their control in such a manner as to further that declared policy of the United States "to the fullest extent

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[7] Shortly thereafter ICAO Annex 16, essentially a similar requirement, became an international standard.

consistent with their authority under Federal laws administered by them." The Environmental Protection Agency was authorized to propose noise regulations to the FAA.

In 1973 the building of 2 or 3-engined jet transport over 75,000 pounds in gross weight, regardless of when the design was certificated, was prohibited unless it met FAR 36 on and after December 31, 1973 (December 31, 1974, for 4-engined aircraft). However, no rule was established to require a "retrofit" of the existing fleet. From that point on there has been a continuous battle inside and outside the government between environmentalists and the air transport industry over both the need and desirability of "retrofit" versus gradual replacement and also how the costs should be borne.

The record shows a long history of attempts by different groups to have the FAA cover already built jet aircraft, i.e., "retrofit." An extensive but not complete list of those efforts at the federal level is given following.

Attempts at Covering the Already Built Planes, i.e. "Retrofit"

1.	11/4/70	Advanced notice of proposed rule making (ANPRM 70-44)
2.	1/3/73	ANPRM 73/3
3.	3/22/74	NPRM 74-14 mandating 100% compliance with FAR over 4-year period
		-Oct. 1974 DOT 23 airport study
		-Dec. 1974 Draft environmental impact statement
4.	1/75	NPRM 75-5 proposal by EPA
5.	7/75	FAA, before the Subcommittee on Aeronautics and Space Technology, endorsed retrofit of the commercial fleet

6.	8/12/75	FAA recommended to Secretary of DOT that he send retrofit plan to OMB and the White House.
7.	12/3/75	FAA, before House Committee on Public Works Aviation Subcommittee, endorsed retrofitting.
8.	1/76	FAA produced two new studies for retrofit: (1) Aircraft Noise Reduction Approaches to Mitigation (2) International Implications to Retrofit
9.	2/76	FAA again, before the same committee, endorsed retrofit.
10.	2/10/76	Secretary Coleman made commitment to decide retrofit question in 60 days.
11.	4/6/76	Secretary Coleman announced he could not meet the deadline - he needed time to analyze an ATA proposal.
12.	6/1/76	Secretary Coleman completed his "Airport Noise Policy Statement" and forwarded it to OMB. It was not made public.
13.	7/76	The Attorney General of the State of Illinois served notice he would sue the FAA for violating the Noise Control Act of 1972 because FAA has failed to carry out its non-discretionary duty. It was now 7 years since FAA was given the authority (1968 Sec. 611) and 4 years since it was directed to act.
14.	9/4/76	Secretary Coleman was scheduled to present his "retrofit" policy to the Subcommittee on Aviation of the House Committee on Public Works. Secretary Coleman postponed meeting because he needed "a few more days."
15.	9/9/76	Secretary Coleman again was scheduled to present his noise policy to the House subcommittee. At the last minute, the Secretary reported he was unable to get clearance from OMB and the White House.
16.	9/21/76	Secretary Coleman was once again, a fourth time, scheduled to present the administration's plan on "retrofit-replacement." Hearing cancelled.
17.	9/30/76	Secretary Coleman, a fifth time, asks "indulgence" over noise delay (Aviation Daily).

18. 10/18/76 "President Ford indicates Early Noise Policy Unlikely" (Aviation Daily).

19. 10/21/76 "President Ford has instructed the FAA and DOT to extend the 1969 and 1973 noise standards 'to all domestic U.S. commercial aircraft...to become effective Jan. 1, 1977, and be phased in over the next eight years'." More hearings on financing were ordered to be held. (Aviation Daily).

20. 10/22/76 Announcement was made that the States of Illinois, New York and Massachusetts jointly filed suit in U.S. District Court, Washington, D.C., against Secretary Coleman, the Administrator of the Federal Aviation Administration John McLucas, and the Administrator to the Environmental Protection Agency, Russell E. Train, for failure to perform their non-discretionary duties of promulgating airport and aircraft noise regulations under Section 7 (b) of the Noise Control Act of 1972.

21. 11/18/76 Secretary Coleman announced that the FAA would shortly promulgate a noise control rule involving a phased retrofit program in steps over a maximum eight-year period. Hearings on methods of financing were confirmed for December 1.[8/]

22. 12/1/76 A one-day hearing before Secretary Coleman was held in Washington, D.C., on the issues of financing aircraft noise reduction requirements.

23. 12/23/76 The FAA published in the Federal Register an amendment to Part 91 of the Code of Federal Regulations (14CFR91) which added subpart E requiring airplanes of over 75,000 pounds to meet the current Federal noise standards in accordance with a phased time schedule of not more than eight years beginning January 1, 1977, and ending January 1, 1985. Contrary to previous understandings, implementation was not tied to any financing legislation.

To summarize: The FAA, under pressure for several years by environmentalists to require commercial jet aircraft manufactured before 1974 to be retired or comply with FAR 36 as promulgated in 1969, and under pressure from the airline industry to take no retroactive action, finally, in the last days of the

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8/ Aviation Noise Abatement Policy, Office of the Secretary, FAA, Nov. 18, 1976. 61 pp.

Ford Administration, notwithstanding a public commitment to take no action unless it were tied to financing legislation, promulgated a rule requiring retrofit, re-engining, or replacement to be effective in eight days but with a phase-in by steps. In the absence of a provision for financing, the airline industry felt betrayed.

How this breaking of faith came about in such a fashion that the responsible persons were not accountable is a fascinating story on the vagaries of politics at the time of an outgoing administration.

The noise regulation was being handled by the Administrator of the FAA, Dr. John L. McLucas, while the companion financing proposal was being developed by the Secretary of Transportation, William T. Coleman, Jr. As is explained in more detail later, both the proposed noise rule and the financing proposal became hot political issues. Both were sent to the Office of Management and Budget in the Executive Office. After several meetings, some attended by President Ford, no agreement was reached. Finally, the President asked Messrs. McLucas and Coleman to the White House to determine the final policy. McLucas supported the noise rule with the financing and Coleman presented and supported a financing proposal involving a reduction in the ticket tax by 2% and a concommitant surcharge of 2% with such monies to be used only for retrofit, re-engining, or replacement.

President Ford did not make a decision in their presence but asked them to go back to their offices and he would advise them of his conclusion. Sometime later Dr. McLucas received a letter from Ford telling him to promulgate the noise rule. The President at the same time also wrote to Secretary Coleman telling him that the financing proposal was not approved. Thus each man received a different letter and each could say he did not break his word to the industry. In a few days all three participants were out of office and had no responsibility for the future.[9/]

9/ Explanation of FAA Administrator John L. McLucas at AIAA Forum "The Future of Transportation" Washington, D.C., Jan. 13, 1977.

Airline managements are in a difficult position in the noise controversy. On the one hand, they cannot be against lower noise levels for three reasons: (1) it is akin to being against motherhood, (2) quieter planes attract more passengers, and (3) the consequences of failing to reduce noise may result in curfews, or even outright bans locally on jet operations. In essence, the failure to deal with noise satisfactorily from society's viewpoint may place serious constraints upon the industry. On the other hand, should the costs of retrofit or replacment by jets with acceptable noise levels exceed the ability of the industry to pay for them either alone or with such assistance as society is willing to give through legislation, then the industry is also constrained. Thus, for those carriers which have significant numbers of non-complying jet aircraft (about 1,600 in number), whether to keep, retrofit, or retire and replace, absent a known government policy, complicates and delays their equipment planning.

The current noise problem will not go away. The question is not whether special interest groups may be able to prevent federal legislation, but how can the differing interests of the population close to airports, the traveling public, the public at large, airlines and the manufacturers be accommodated in the manner best suited to society?

During the past several years countless hearings on noise rules have been held not only in Washington, D.C. but all over the United

States.[10/] Even a summary would be too long to include here. However, to understand the delays and some of the complexities of the problem which make for uncertainty in the minds of the decision maker a few points are in order.

(b) Impact of Legal Problems: Complaints about noise led to lawsuits. The Supreme Court in Griggs vs. Allegheny County, 369 US 84 (1962) established that airport operators are liable for noise damages resulting from operations to or from their airports. Thus it was not the makers of the noise that were liable. From this one would conclude that each airport operator could make his own rules. If so, the air carriers in particular could be subject to a thicket of conflicting regulations which would be unworkable and intolerable. The Ford administration's view was that the current Section 611 of the Federal Aviation Act furnished a means of preventing such a conflict by providing the FAA with authority to preempt noise regulation of air carriers. However, until the FAA acted the airport proprietors were free to make their own rules, subject to being nondiscriminatory and not being unduly burdening on interstate commerce. As long as the FAA did not make a regulation covering existing non FAR 36 aircraft, the carriers through their Air Transport Association would be kept busy putting out

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10/ U.S. Congress, House Committee on Public Works and Transportation, Current and Proposed Federal Policy on the Abatement of Aircraft Noise, Hearings before the Subcommittee on Aviation of the House Committee on Public Works and Transportation. 94th Cong. 1st and 2nd sessions, 1975, 1976. 1439 pp. See also the same subcommittee hearings titled Airport and Aircraft Noise Reduction, Hearings before the Subcommittee on Aviation of the House Committee on Public Works and Transportation on H.R. 4539 and Related Bills. 95th Cong., 1st session, 1977, 567 pp.

fires around the country where aggressive local groups pressured airport authorities to propose regulations involving curfews and outright banning or progressive banning of operations by nonconforming aircraft.

The pressures locally are far more than mere strong expressions of desires. As a result of legal proceedings Los Angeles has been ordered to pay more than $1.7 million in damages because of noise. In addition, $24 million has been paid in negotiated settlements. What is more, the California courts have held that noise damages may be not only for loss in property values but for mental and emotional distress (Greater Westchester Homeowners Association, et. al., vs. City of Los Angeles, et. al. Self-supporting airport authorities must face the payments by increasing their landing fees and rentals from airlines. This will, of course, further increase fares and thus decrease the demand for air transportation. One attempt to minimize the problem has been to employ land use planning in which homes near the noise path are acquired and the land re-zoned for other uses. Because land acquisition is very expensive (Los Angeles has spent $160 million in 5 years) airport authorities push hard for a "retrofit" or "replacement" solution.

As indicated by items 13 and 20 shown on pages 21 and 22, local pressures intensified and were aggregated first to individual state pressure and ultimately to the point where three powerful state governments (Illinois, New York and Massachusetts) banded together to exert further pressure in the form of a suit.

Inasmuch as the federal government had the authority to impose noise regulations for existing non FAR 36 aircraft which constitute 75 to 80% of the fleet, and since it is somewhat unusual for bureaucracy to fail to exercise authority, particularly in the face of public pressures, one can ask why this delay which brought such uncertainty to managements' decision process? These are three primary answers:

(1) The time-consuming nature of the rule-making structure and attendant bureaucratic infighting.

(2) Time for solving legal and political considerations.

(3) Industry opposition

Rule-making Structure and Bureaucratic Infighting: Delays as a result of hearings are nothing new in Washington. However, in this case because of the manner in which Congress has structured the process by placing so many agencies and offices "in the loop," the art of delay through hearings has reached a new high. The bureaucratic maze is somewhat as follows.

The FAA may promulgate a rule and in 1970 issued Advanced Notice of Proposed Rule Making (ANPRM) 70-44. This was followed in 1974 by NPRM 74-14 which, of course, generated comments. In 1975 the EPA originated NPRM 75-5. An office of Environmental Quality in the FAA works on these matters. However, the FAA is not an independent agency and must "consult" with the Secretary of Transportation. Some space in the congressional hearings was devoted to "suggesting" that in fact "consultation"

was a euphemism. It was pointed out that even the testimony of the FAA Administrator had to be approved by the Office of the Secretary of Transportation before he appeared before a congressional committee on the subject.

Lack of action by the FAA caused Congress to include in the Noise Control Act of 1972 further legislation affecting jet aircraft noise control. There was some debate favoring removing noise control from the FAA and giving it to EPA. However, Congress finally provided the EPA with the authority to propose rule changes to which the FAA must respond affirmatively or give the reasons why not. The purpose was to continue the FAA "in the loop" because of its expertise, but to use the EPA to keep the FAA's nose to the grindstone. Under this legislation the EPA had, by the end of 1975, proposed 8 rules and were working on others.[11/] Subsequently, by 1977, the list had grown to 11. The EPA has its own staff not related to the FAA. The process in making an EPA proposal takes time. Suppose, for example, that the FAA is just about to promulgate a rule when it receives an EPA proposal. The FAA may quite properly hold up its rule to consider the new proposal. This procedure can trigger more hearings. The process can be endless.

Another actor in this bargaining over what type of noise abatement rules are appropriate is the Council of Wage and Price Stability (COWPS) in the Executive Office of the President. This agency

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11/ Hearings, Current and Proposed Federal Policy on the Abatement of Aircraft Noise. House Subcommittee and Aviation, Dec. 3, 1975, p. 123.

came into being in August 1974 (Public Law 93-387). The act, as well as Executive Order 1182 of November 27, 1974, directs the Council to review the policies, programs and activities of the departments and agencies to determine the extent to which these programs and activities are contributing to inflation. COWPS has been at odds with the FAA and EPA on various points. After analysis of the EPA's proposal to FAA, COWPS faulted the EPA for not providing an Environmental Impact Statement as required, and sided with the airlines that the rule was (1) unnecessary from a health and welfare standpoint, (2) that the rule only accelerated benefits which would come about anyway, (3) that the rule failed on a cost benefit analysis, and (4) that the rule was inflationary.

Thousands of pages of testimony, technical reports and position papers have reached the public view as a result of activities of the EPA and FAA. When the FAA proposal leaves the FAA and begins its course through the Secretary of Transportation's office, the OMB, and perhaps the State Department and other agencies and departments, a curtain of secrecy descends. This is where the behind-the-scenes maneuvering in Washington can take place. Whether these subsequent "evaluations" are made only on the basis of the record, or are the whole new ball game in which the "tilt" goes to the actors with political skill is not clear.

In the present case an FAA proposal went to the Secretary of Transportation. His office also has legal, technical and economic staff to work on the problem. Inputs were received from the industry which did not favor the FAA plan. It was reported in the press

that the Secretary adopted in general the approach of the Air Transport Association and sent it on to the White House where the OMB became involved. The size, if any, of the specialized noise staff on noise control in OMB is not available. Instead of a prompt decision the matter was hidden for months. What reports that did come from the "usually reliable sources" were that Secretary Coleman's proposal for an administration position did not "fly" with the "White House OMB staff." On various occasions, notwithstanding reported meetings with President Ford, Mr. Coleman, as noted above, was forced to delay his testimony.

Of course rules proposed by agencies such as the FAA or FHWA for transport operating equipment do not normally find their investigations replicated at other higher levels of government, so the question is why in this case? The answer lies in the fact that the industry has successfully argued that it would be unfair if not unconstitutional to adopt a rule which the industry in its current financial situation could not afford. Support to the logic is found in Section 611 of the amended FAA Act which includes the statement that the regulation must be economically reasonable. Accordingly, in the absence of available private financing, some governmental legislated assistance would be needed. The FAA then adopted the position that it would not promulage a regulation until appropriate legislation was passed.[12/] However, since legislation could have an adverse effect on the revenues of the government by diverting taxes

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12/ Ibid., Testimony of Frederick A. Meister, Associate Administrator, FAA, Dec. 3, 1975, p. 69; also, testimony of Dr. John McLucas, Administrator, Federal Aviation Administration, pp. 1154 and 1159.

from the Airport and Airway trust fund to private carrier accounts, the OMB and the White House became involved. Nevertheless, if the matter drags too long, Congress may move on its own.

Legal and Political Considerations: First is the problem of federal preemption. In order to have one set of rules to live by, the aerospace and airline operators have pressed for federal preemption of noise control. However, wholesale transfer to the federal government might also mean transfer to it of the burden of combatting countless lawsuits and perhaps, subject it to enormous liability. The government is reluctant to take this big a bite of the apple.

What rights should be left to the local governments? In July, 1975, there was proposed in the Federal Register for comment a National Airport Policy with four options: (1) All control would reside with the local authorities, (2) the local proprietor would establish a policy which had to be reviewed and approved by the FAA, (3) a proposal that the local operator be constrained by the FAA, with a coordinated federal plan, and (4) proposed proceeding on a case-by-case basis.

Secondly, time is required to assess a correct balance of the rights of various segments of citizens. On the one hand, the environmentalists testified to the decreasing quality of life near the airport coupled with a decrease in property values, mental and emotional distress, physical damage to property, and adverse effect on the educational system in schools located near airports. Other

interests downgraded this testimony and pointed out the catastrophic adverse effect on not only local business but on employment, business in the region and, in fact, the entire country if the environmentalists were to be satisfied.

Finally, when it came to outright government provision for aid in retrofit or replacement, a provision which the industry and ostensibly the Secretary of Transportation favored, there were several in the industry who secretly, and perhaps not so secretly, were exerting pressure where they thought it would do the most good to keep the proposal bottled up. Delta, with strong finances and an aggressive fleet modernization program of its own, strongly felt that it had a lower cost exposure to a noise regulation, whatever it might be, through past sound management practices and hence, it was not right for it and the public to be taxed to cover faulty management of others. Northwest was in the same position. Both carriers stand to be in an enviable competitive position should a rule go in without financial aid to the weaker carriers. It is not inconceivable that less well-situated carriers such as Eastern and TWA could be driven to the wall.

The financial aspects are dealt with in detail in another section. Suffice to say while insurance companies, commercial banks and investment bankers applaud successful management, nevertheless, they have immense investments in the entire airline and aerospace industry. Obviously, the pressures from this group are for retirement of non-FAR aircraft from their client airlines and replacement

by their client manufacturers. They favor such legislation as is necessary, short of nationalization, to make this possible.

Industry Opposition: The various advanced notices of proposed rule making resulted in a March 1974 proposal which would require jets over 75,000 pounds in weight to meet the FAR 36 noise rule on a phase basis, with 50% compliance by July 1, 1976, and 100% by July 1, 1978. The final rule made public November 17, 1976, changed the four-year timetable applicable to all aircraft to six years for the wide bodies and 727/737/DC-9/BAC-111 and to eight years for the old first generation jets such as the 707/720/DC-8 and 990.

Industry opposition as represented in the various responses to the proposed rules and in Congressional hearings were, except for the well-financed carriers, identical with the points made to the investigators privately by individual carrier managements as indication of a deep conviction on their part. Briefly, the arguments may be enumerated as follows:

1. The ATA, while encouraging more stringent rules on new aircraft, argued that the technology currently available for noise control via retrofit resulted in minimal noise relief. The extent of relief possible was vigorously disputed.

2. The cost of accomplishing retrofit with sound-absorbent material (SAM), given its limited effectiveness, produced an inadequate benefit/cost ratio.

3. Retrofit by refanning the engines was not a viable approach because it was five times higher in cost.

4. The cost of replacing the engines with those of newer technology on the noisy aircraft was such a high multiple of straight retrofit using Sound Absorbent Materials (SAM) that such an option was clearly eliminated.

5. Those companies with the greatest number of old non-FAR 36 airplanes could not afford retrofit.

6. Replacement of the old less fuel-efficient and noisy airplanes by newer technology, quieter, more fuel-efficient planes, while very desirable, was not a viable alternative because no such planes of appropriate size and economics were currently available from aircraft and engine manufacturers.

7. The retrofit rule at great expense would only move up in time that which would take place in time anyway.

8. Current noise levels are not a health hazard but only an annoyance.

9. Acting favorably on retrofit would be inflationary.

The advisability of carefully evaluating these arguments contributed to the delays.

(c) Noise Proposal of November 1976 - Impact: A few facts can set the current retrofit replacement controversy in perspective. In the free world at the end of 1976, there were approximately 4200 jet aircraft in commercial airline service (Table 2), of which 2,050 were in the United States. The ATA calculated that in the U.S. its member airlines operated about 1601 aircraft which did not meet the FAR 36 standard and only 389, or 20%, met FAR 36. The breakdown by aircraft type follows:

	Number of Non-FAR 36 Aircraft	Number of FAR 36 Aircraft
707	268	0
720	18	0
DC-8	161	0
DC-9	330	7
727	620	136
737	122	2
747	51	44
BAC-111	31	0
DC-10	0	122
L-1011	0	76
Total	1601	387

Source: ATA, Table furnished House Subcommittee on Aviation 1976. House hearings on HR 4539, p. 797.

Various estimates have been given for the cost of retrofit per aircraft with the following figures being representative including installation. The total ATA Fleet Cost was calculated at $1 billion.

	Cost of Retrofit Per Aircraft 1980 Dollars
707	$ 2,160,000
720	2,160,000
DC-8 21/31	516,432
DC-8 62/63	1,678,404
DC-8 50/61	2,323,000
DC-9	273,000
727	195,000
737	432,000
747	483,000

Source: ATA Table dated 2/12/76 furnished House Subcommittee on Aviation. Hearings on HR 4539 p. 797

The impact of the rule affects each carrier differently, depending on the age and composition and degree of modernization of

its fleet. The number of non-FAR aircraft for selected carriers are depicted below:

	AAL	UAL	TWA	PAA
707	88		100	51
DC-8		101		
DC-9			19	
727	99	150	35	13
737		59		
747	11		11	0
	198	310	165	64

Proponents of retrofit point out that at the end of 1975 82% of the jet fleet did not meet FAR 36 and, unless something were done, by 1990 there still would be 48% of the aircraft not complying.

These carriers in the table above are the very airlines which in the past have initiated the re-equipment cycle with new more efficient aircraft, and indeed, the launching of a new generation of more efficient craft depends upon orders for a quantity of aircraft which only these carriers are of a size to purchase. Their current perception, aside from their current financing problems, is that the required retrofit will indeed, in many cases, make it more advisable to replace, rather than retrofit, at least their 707's and DC-8's with a known quantity, such as the 727-200, even though such craft may not be the optimum size for their operation, and even though a new technology or derivative airplane is under development. The carriers also expressed the fear that if legislation were passed to encourage them to meet the new rule by retrofitting, the end result would be that they would have spent

their available funds and then be in no position to take advantage of the next newly developed aircraft when it becomes available. Such a situation could have adverse effects on the aerospace industry and hence on the economy as a whole.

The total cost of retrofit only was first presented as 536 million in 1974 dollars. In February 1976, the ATA presented cost estimates of $1 billion for retrofitting U.S. aircraft only. These figures do not include $87 million expended by NASA in efforts to assist R & T for developing SAM and refan engines. Secretary Coleman's mid-November 1976 press release indicated an expected cost of from $5 to $8 billion for a combination of retrofit and replacement.

Extent of Relief from Retrofit: A major source of controversy between the industry and those favoring retrofit involves a dispute as to whether retrofitting non-FAR airplanes with SAM would afford meaningful relief. The proponents (FAA, EPA, various community interest groups) pointed to testimony by a number of psychoacousticians whose thrust was that the EPNdB reduction afforded by SAM was measurable and significant.[13/] Defining meaningful noise reduction as 6 EPNdB as measured by sensitive instruments, the psychoacousticians found reductions in noise of such magnitudes as 11 on takeoff and 15 on approach for the JT3D 707's, and 2-4 on takeoff and 8 on approach for the JT8D smaller airplanes. Some 727's had lower

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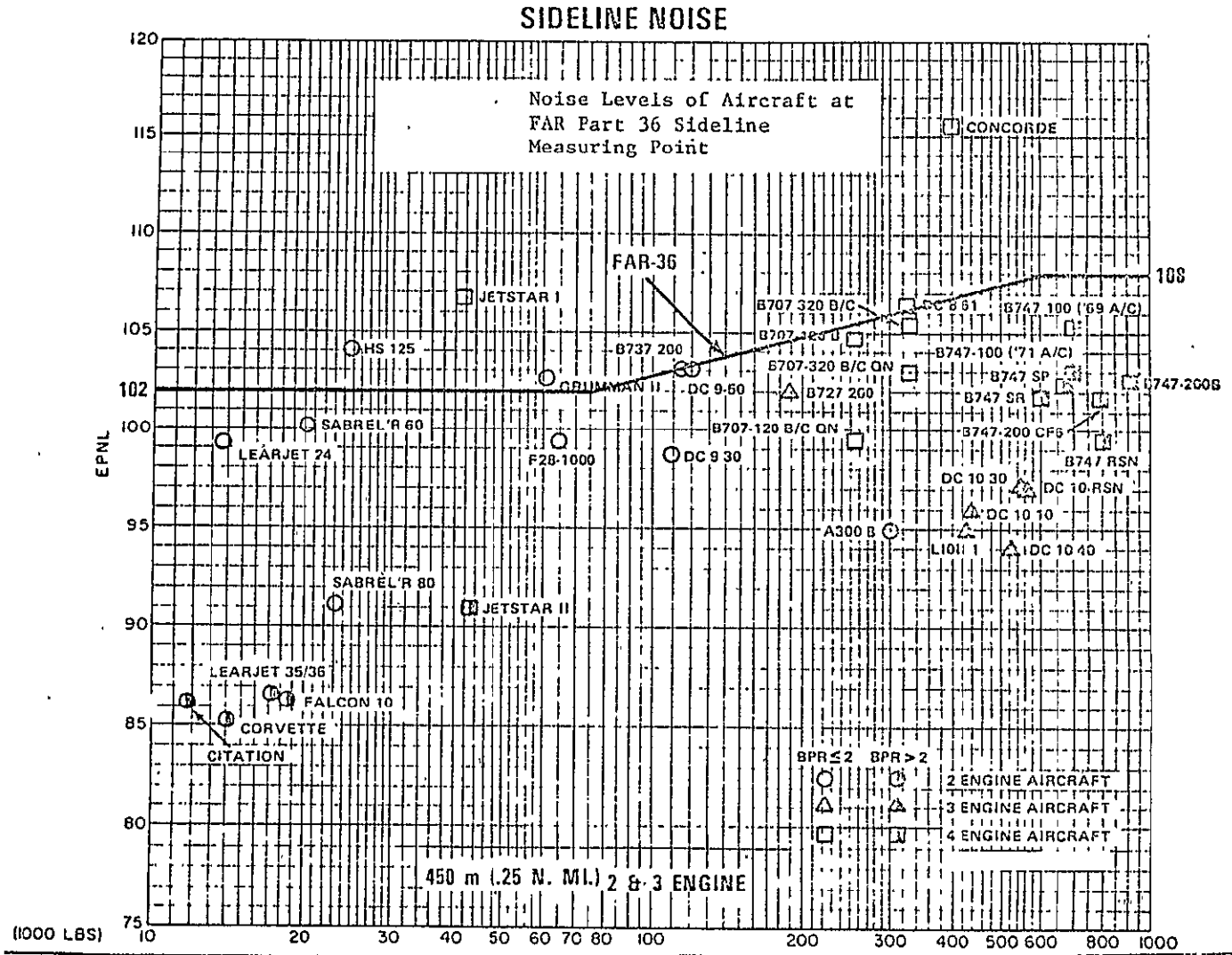
13/ Ibid., Testimony of Paul N. Borsky, Columbia School of Public Health; Dr. Karl Kryter, Stanford Research Institute, and Kenneth Eldred, Vice President of Bolt Beranek and Newman, Cambridge, Mass., pp. 1057-1150.

values. The 707 and DC-8 constitute only 15% of operations. On the other hand, the opponents of retrofit (airlines and manufacturers), while submitting reasonably similar estimates for the 707's, found lesser figures for other aircraft. They also vigorously pressed two other points to widen the difference of opinions: First, retrofit was most effective on approach for the 707 type but of little use on takeoff; and takeoff was the configuration making the most noise. Secondly, in general, the JT8D (727/737/DC-9) retrofitted planes benefitted only by 7.9 EPNdB on approach and 2.2 on takeoff. Third, the opponents disputed the meaningfulness of a threshhold of 6 EPNdB. Using data from actual "flyover" experiences in the field plus an audio-visual presentation of tape recorded "flyovers," an attempt was made to demonstrate to the Congressmen that the human ear did not register the sounds in the same way as did the instruments.[14/] The argument was that a person hearing a retrofitted 727 cannot tell the difference between it and a non-retrofitted craft. With 85% of aircraft operations employing this power plant, the whole SAM program was said to lack justification.

Charts 1, 2, and 3 on the following pages, taken from the FAA Final Environmental Impact Statement (EIS) of November 10, 1976, depict graphically the extent to which selected jet aircraft deviate above or below the FAR 36 standard for the three measuring points. Standing out above the FAR 36 line for takeoff and approach are the early Boeing 707's and DC-8's as well as the very early Boeing 747's.

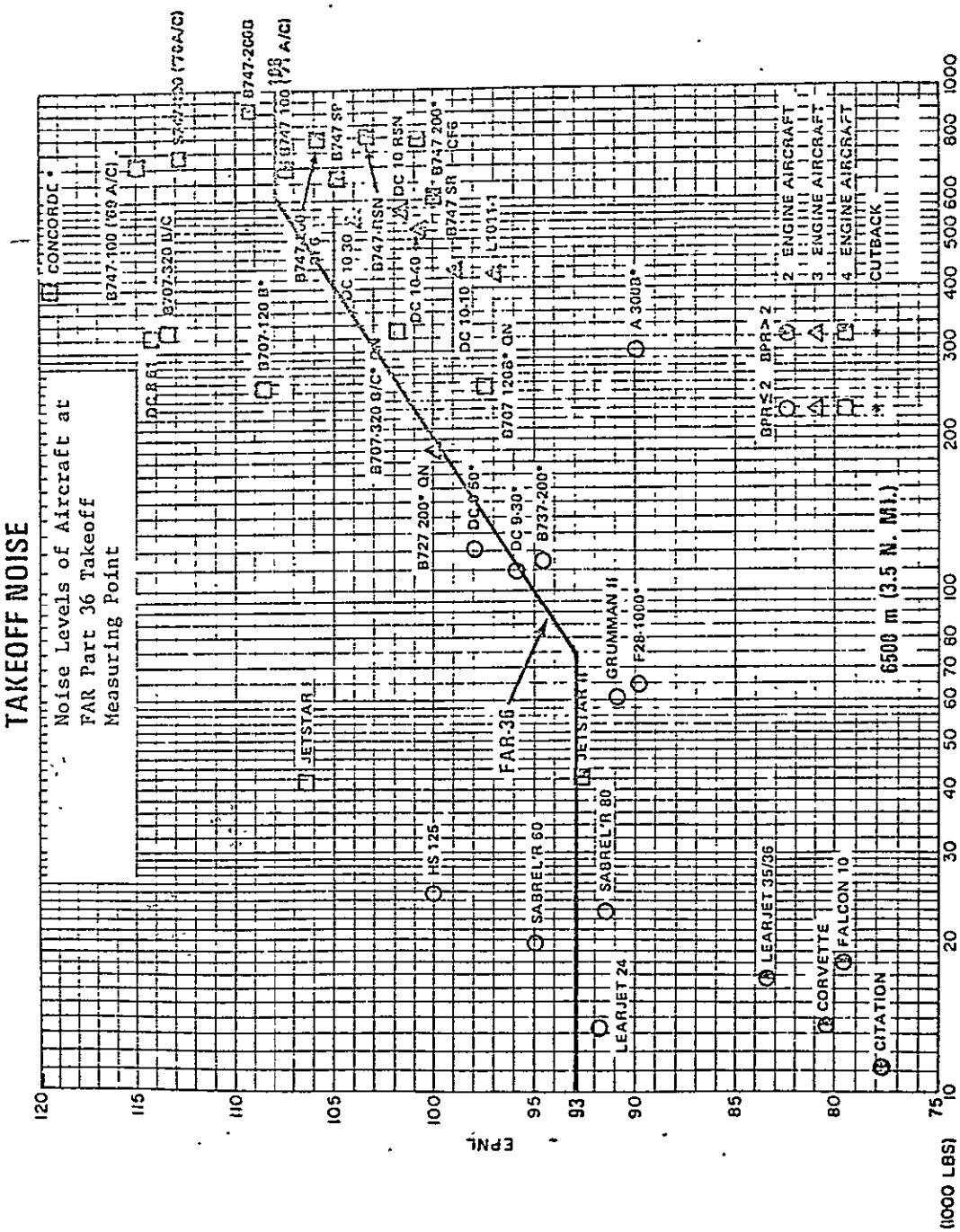
14/ Ibid., January 22, 1976 testimony of A.L. McPike, McDonnell Douglas Corp., pp. 311-412.

Chart 2



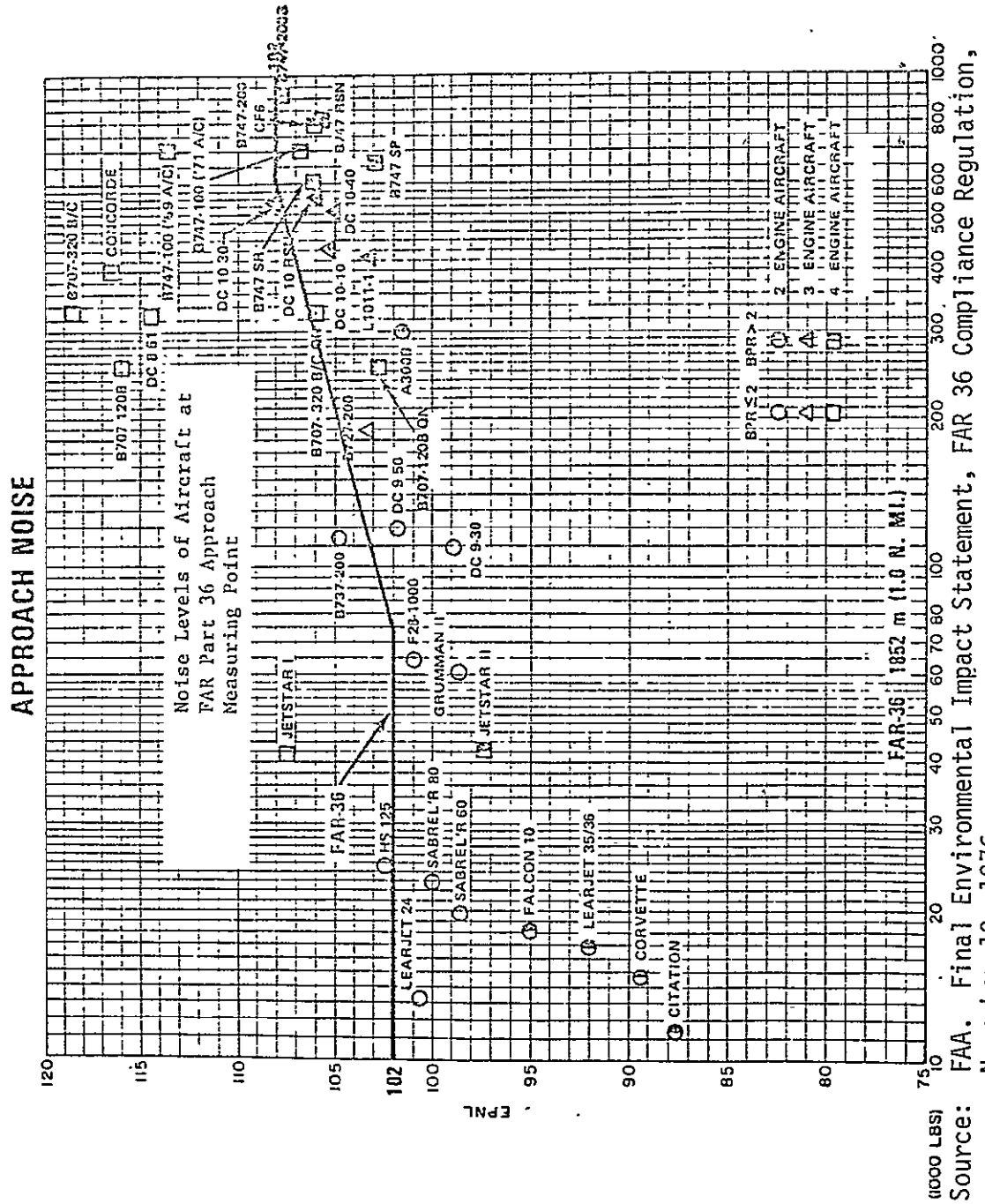
Source: FAA. Final Environmental Impact Statement, FAR 36 Compliance Regulation, November 10, 1976

Chart 1



Source: FAA. Final Environmental Impact Statement, FAR 36 Compliance Regulation, November 10, 1976

Chart 3



Source: FAA. Final Environmental Impact Statement, FAR 36 Compliance Regulation, November 10, 1976

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OF POOR QUALITY

Well below the line for takeoff and approach are the wide-bodied DC-10's, Lockheed L-1011's and newer Boeing 747's. For some reason the 727-100 series is not shown. If it were, it would be only one EPNdB higher than Part FAR 36 for approach and 6.5 EDNdB high on takeoff.

Additional comparisons as shown by the FAA under FAR 36 certification conditions are found in Table 3 on page 43.

Conclusion: During the past several years, thousands of pages of testimony have been taken; designs for retrofit have been formulated; NASA has spent $87,000,000 in re-engine and refan research; the EPA has presented a number of proposals and the FAA up to the end of 1976 indicated that no noise rule would be promulgated unless satisfactory financing was tied in. Experts can be found to say that the SAM program is meaningful and others that it is not. While certain airlines due to their finances, equipment, and competitive posture would not be upset with a retrofit required of all at each airline's expense, such is not the case with those large carriers who might be expected to initiate a new equipment cycle. The uncertainties of what the government will do have complicated their equipment plans. If only the financing of retrofit were to be done with government assistance, it is quite likely that purchase of new equipment would be put off. Also, if financing legislation were drawn so as to make re-engining of the noisy aircraft more advantageous than replacement, purchase of new planes would be held back. On the other hand, if the financing of noise abatement were to be

TABLE 3

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION
FINAL ENVIRONMENTAL IMPACT STATEMENT

NOISE LEVELS UNDER FAR 36 CERTIFICATION CONDITIONS (EPNdB)

Aircraft	Condition	FAR 36 Limit	Unmodified	Fully Modified
707-320B	Takeoff	103.7	113.0	102.2
	Approach	106.3	116.8	104.0
	Sideline	106.3	102.1	99.0
DC-8-61	Takeoff	103.5	114.0	103.5
	Approach	106.2	115.0	106.0
	Sideline	106.2	103.0	99.0
727-200	Takeoff	99.0	101.2	97.5
	Approach	104.4	108.2	102.6
	Sideline	104.4	100.4	99.9
737-300	Takeoff	95.8	92.0	92.0
	Approach	103.1	109.0	102.2
	Sideline	103.1	103.0	103.0
DC-9	Takeoff	96.	96.	95.0
	Approach	103.2	107.0	99.1
	Sideline	103.2	102.0	101.0
747-100	Takeoff	108.0	115.0	107.0
	Approach	108.0	113.6	107.0
	Sideline	108.0	101.9	99.0

Source: DOT Environmental Impact Statement in Response to NPRM 74-14 and 75-5, Statement of Nov. 11, 1976.

tilted toward replacement, one would expect retirement of the current narrow-bodies as fast as production of new equipment would allow. The situation would be more uncertain than it is if, indeed, a satisfactory replacement airplane were "on the shelf" waiting to be purchased. However, as will be seen in the technology and economic sections, a plane (or planes) of the right size and right economics is (or are) not yet currently available: nor is the financing for such aircraft settled. In any event, until the carriers and manufacturers have a clear notion of the noise rule application, its cost and who pays for the modification, intelligent decisions cannot be made. Thus, it can be said that the FAR 36 controversy is a significant factor affecting the retirement of current jet aircraft.

D.

FINANCING LEGISLATION: ITS EFFECTS ON THE RETIREMENT OF JET AIRCRAFT

The preceding section dealt primarily with the controversy over retroactive application of the 1969 noise rule to previously built planes. The point was made that the uncertainty which the controversy engendered served only to delay retirement decisions. On December 23, 1976, the announcement of the implementation of a retroactive rule for 2,3, and 4-engined transports weighing over 75,000 pounds removed the uncertainty of whether there would be a rule and what it would be. However, absence of the promised companion financing bill coupled with the departure from office of those promulgating the rule created further confusion for a few months. This subsection traces the changing attitudes and policies of the airlines and the ATA from consternation and defiance to acceptance, though less than unanimously, of the rule in concert with a determined push to obtain special legislative interim financing arrangements. We begin with the rule and its time span.

D.1 AMENDMENT 91-136 SUBPART E

Amendment 91-136 extended FAR 36 to cover earlier produced aircraft in accordance with the following time scale.

	Percent of Compliance Required	
Number of Engines: . . .	2&3 engines	4 engines
Airplane Type:	727/737/DC-9	707/DC-8/880/990
Engine Type:	JT8D	JT3D
Jan. 1, 1981	50%	25%
Jan. 1, 1983	100%	50%
Jan. 1, 1985		100%

According to the Policy Statement, in establishing these dates the Administration took into account the length of time needed to develop, certificate, produce, and install retrofit kits for those airplanes for which the operators would decide that retrofit was the best course of action. Since the 747's, 727's, 737's and DC-9's were newer and closer to meeting FAR 36, these would be the prime candidates for retrofit, other things being equal. The longer time from the estimated time of production decision to first kit delivery for the 707 and DC-8 was said to be 2-1/3 and 3 years respectively. A more potent reason was the belief that certain models of the 707 and DC-8 were old, noisy, and inefficient so that replacement would be the best course of action. The passage of time from go-ahead to introduction could easily be four years. Since no designs satisfactory to the airlines had been completed, and since financing currently would be a difficult problem, time was needed.

Initial Reaction to Part 91 Amendment 136

Prior to President Ford's October 21, 1976, acceptance of the proposal of the FAA Administrator and Secretary, which later became 91-136, the industry was reasonably well resigned to some new noise rule coupled with a means of financing compliance. Additionally, there was cautious optimism that the rule would not affect the 2 and 3-engine jet aircraft. The promulgation on December 23 of the retrofit rule which included these very planes and, in addition, failed to be accompanied by financing assistance, left the

industry aghast and with the feeling of betrayal. The ATA had built its favorable reception of new noise rules for the 707 and DC-8 on the quid pro quo of financial help.

Interviews with industry decision makers in early 1977 indicated that the industry would not accept the rule and would fight in the new administration to have it set aside and that the industry would simply take advantage of time and not order any retrofit kits, thus presenting the government with the dilemma of grounding those planes beginning in 1981 or of cancelling the noise rule and having the environmentalists rise up en masse. If this scenario had held, there would have been little or no retirement of jet aircraft.

However, on reassessing the situation a different course of action was decided upon. The Air Transport Association and the individual Federal Affairs representatives of the airlines and aircraft and engine manufacturers had developed rather effective representation with various Senators and Representatives in which they made the most of the point that new airplanes meant jobs at a time when unemployment was a national problem. They also made the point that new aircraft would be quieter and hence more socially acceptable and therefore would be a means to getting the environmentalists off the legislators' backs. Finally they pointed out that new aircraft would be much more fuel efficient. Therefore, the industry decided to press for new bills in Congress providing for the type of financial assistance which had been proposed by the

ATA in 1976 and had only been abandoned when President Ford sent his separate letters to McLucas and Coleman.

D.2 COMPONENTS OF A SALEABLE BILL TO ASSIST RETIREMENT OF AIRCRAFT

One of the primary reasons why the noise financing proposals did not "fly" when they reached the upper echelon in the Ford Administration was the fear not only that they would be viewed as special interest bills for airlines, aircraft and engine manufacturers and banks, and therefore many other businesses would attempt to seek similar special treatment to assist them in retiring their equipment. Accordingly, a bill which could be labelled "the aerospace and airline relief plan" would have little chance of success. On the other hand, the many hearings both in Washington and around the country had clearly shown that the noise problem developed haphazardly because of the failure of the Federal Government, the manufacturers, the airport proprietors, the State and local government and planning agencies, the air carriers, and residents at or near airports to take such steps as were necessary to alleviate it.

The November 1976 Aviation Noise Abatement Policy document marshalled the facts and pointed out that it would take all the parties acting in coordination to reduce the impact of noise. Control of aircraft noise at the source - a matter for the manufacturer and the airlines - was just one, albeit a very important, element of the problem. As long as airport proprietors failed to acquire enough surrounding land, as long as cities zoned in such

a way that homes could be built immediately adjacent to the airport or under a takeoff or approach path, and as long as the Federal Government failed to consider adequately the noise implications of operational procedures or of air traffic control, the noise problem would not be solved. Thus the policy statement formed a solid basis for developing a series of bills known in general as the Airport and Aircraft Noise Reduction Act.

At the time of the decision by President Ford, on October 21, 1976, to order a retroactive application of FAR 36 (just 3 days after he had indicated an "early noise policy" was unlikely) his advisors had convinced him for political reasons not to include financing legislation. The White House position was that the passage of the Airline Deregulation would be sufficient. However, immediately after the election while under strong pressure from the ATA he authorized a one-day hearing on December 1 to determine whether any additional financing arrangements were necessary. Secretary Coleman himself presided over this hearing. Shortly thereafter once again Secretary Coleman recommended legislation embodying financing assistance. Subsequently, a few days before leaving office, President Ford drafted a message to Congress proposing legislation which would have provided for the establishment by the CAB of an environmental surcharge on passenger and freight tariffs to be offset by an equal reduction in the air passenger and freight tariff tax. Grants to airlines from existing balances in the Airport and Airway Trust Fund would assist in financing modification of aircraft

specified by the Secretary of Transportation. Time prevented any hearings so the bill was dropped with the basic concepts surfacing in a series of bills beginning in March 1977.

To summarize, as a new administration took office at the beginning of 1977 the airlines were faced with a "fait accompli" - a rule requiring that 75% of their fleet be retired or modified over a time span but with no financing aid. The policy statement of November and the hearings in December provided the underpinning for the components of a majority of the bills which followed. After much maneuvering and compromise in December 1977, the House Committee on Public Works and Transportation completed work on HR 8729, Title III which was directed toward financing of retrofit, re-engine, or replacement. Unfortunately analysis of this bill alone will not demonstrate the extent to which legislation can affect the posture of airlines toward the retirement problem. The balance of this section will give an indication of how public policy can counteract the normal economic process of decision making so as to in fact influence technology. Not only the timing of financing aid and the "tilt" of legislation toward retrofit, or re-engine, or replacement but also special tax credits have an important effect on airline and aircraft and engine manufacturers' decisions. This is even more important in the case of airlines with weak financial statements. Therefore it is necessary to review the major bills with particular emphasis on the incentives they provided.

D.3 EMPHASIS ON RETROFIT - H.R. 4539

The new administration, through Secretary of Transportation Brock Adams on the TV program "Face the Nation" in February, emphasized the desirability of replacement over retrofit for the primary reason that sometime between the year 2000 and 2010 the U.S. would run out of petroleum. He did not define how the replacement would be financed. However, on March 7, 1977, Rep. Glenn Anderson (Cal.) introduced the first of several comprehensive bills concerning various aspects of noise abatement. Each of the major bills bore the title "Airport and Aircraft Noise Reduction Act" and contained three to four titles dealing with (1) airport planning and determining one official noise descriptor, (2) additional funding for ADAP under the Airport and Airway Development Act which would take funds out of the Airport and Airway Trust Fund for air carrier and general aviation airports, and (3) financing the retrofit, replacement of engines or replacement of noisy commercial jet transports weighing over 75,000 pounds.

While not in the original H.R. 4539 or in the final version of H.R. 8729, several versions contained a Title IV which militated against preemption by the Federal Government where State and Local Governments were concerned. Since this study is focused on retirement, it will not be appropriate to deal in detail with the provisions of the various bills. However, since the various proposed Title III's involving financing were part of the overall treatment it is advisable to treat the major aspects of the legislation.

3.1 Title I. Comprehensive Land Use Planning

First, in order to eliminate the confusion and lack of comparability of the various noise measurements, the Secretary of Transportation was given the authority and duty to establish a single system of noise measurement. Secondly, there was a mandatory requirement for airport operators to submit (a) a noise contour map showing non-compatible land uses, and (b) a noise compatibility program to control noise. The financing of the above could come from a $2.00 head tax which an operator could levy and from grants made by the Secretary of Transportation. To ensure prompt action, it was provided that if the plan was not disapproved by the Secretary in 180 days, it become effective.

The purpose of the Title was to force the airport operators and local and state planners to make effective contributions to the reduction of noise. Zoning and purchasing land around airports could move residential owners and schools far enough away from the noise to reduce demands on the manufacturers and airline operators for further relief. The effect of a successful application of the title would lessen the pressure to retire current jet aircraft and to minimize demands for more stringent noise limits. By the time the committee agreed upon a bill the mandatory feature and the head tax fell by the wayside.

3.2 Title II. Funding for Air Carrier and General Aviation Airports

An additional amount of $260 million for the fiscal year 1979 and $310 million for fiscal 1980 was provided for the Air Carrier

and General Aviation Airports. These amounts were carried forward in subsequent versions and in the final committee print on H.R. 8729. Initially, Transportation Secretary Adams opposed these additions because the last increase was less than a year previous. There appeared to be no further objection until a memorandum from the General Counsel of the Treasury on September 27, 1977, opposed the addition "as long as the costs of operating the Federal airway system and most of the maintenance costs thereof are funded from the general fund of the Treasury."

3.3 Title III. Financial Aid for Bringing Large Jets into Compliance with Noise Rule

As a base time from which to determine the specific aircraft for which operators were entitled financial aid, the bill provided for an inventory to be made of those aircraft which did not as of January 1, 1977, comply with 14CFR 36 as amended by 91-136. The logic was that on this date the government changed the rules of the game initiating a requirement that airlines spend money which they would not otherwise have had to do. It would also prevent a carrier from after that date purchasing a noisy aircraft just for the purpose of getting government aid in its replacement.

Because the source of funding was to be a surcharge on tickets, the inclusion of private business aircraft would have resulted in a cross subsidy to the owners of such aircraft. The bill, therefore, was limited to planes used for the carriage of persons or property for hire. Military planes were not included. This section was

carried forward in all subsequent bills.

Funding Source: Surcharges on tariffs: A major problem in legislating financial aid for a particular industry is how to avoid the charge that the general population is being taxed to favor special interest groups, in this case the airlines and air travellers. The Air Transport Association thought it found the answer when in the previous year it had suggested that since the balance in the Airport and Airway Trust Fund had consistently been increasing to the point where it had reached $3 billion, the taxes going into it were excessive. It was reasoned that for a temporary period, 10 years in the case of H.R. 4539, a portion of the taxes could be reduced and an equivalent surcharge be put upon the airline customer with the resulting revenues placed into a fund for the sole purpose of financing aircraft noise abatement. Thus, the user would be paying for abating the noise. While this concept was adopted by Messrs. McLucas and Coleman in the spring and fall of 1976, it did not, at that time, "fly" with the Office of Management and Budget and other high Ford advisors. As a matter of record, it did not "fly" with Ford until after the election at which time he transmitted a bill with such a provision. The primary argument against this was that the plan would further unbalance the budget because the percentage now going into the Trust Fund would end up going to the airlines. Although the Trust Fund itself had a balance the overall government budget would be further unbalanced.

H.R. 4539 provided that each operator with a noncomplying aircraft would assess a 2% surcharge on the before-tax tariff.

(passenger or property). This surcharge would be placed into a special account for the purpose of retrofit, replacing engines, or replacing aircraft. The offsetting 2% decrease in the 8% passenger tax was not covered in the bill because it was in the province of the Ways and Means Committee.

It was estimated during the hearings that the 2% tax would yield approximately $4 billion over the 10-year period prescribed in the bill (Table 4).

Formula for Payment from Fund: For our purpose of analyzing the factors affecting the retirement of jet aircraft, the section dealing with the entitlement formula for allocating funds from the special surcharge accounts is of key importance. Some seemingly minor word or percentage changes can significantly alter the retirement plans of operators. This is particularly true of carriers in a weak financial position. As this and subsequent versions of the bill were presented and amended, it was fascinating to observe the ebb and flow of changes as different interests obtained the ear of the legislators and as the legislators bargained within their group for a consensus.

The legislation provided that within 30 days after the publishing of the inventory of noncompliant aircraft, the "owners" (later changed to "operators") would advise the Secretary which of three methods they would employ to bring their aircraft into compliance by the deadline dates. Each of these methods entailed a different financial cost to the carrier. The formula provided reimbursement

TABLE 4

ATA BASIC DATA ON NOISE REDUCTION PROGRAM

Carrier	Total jet fleet Jan. 1, 1977	Nonpart 36 2-3 engine jets Jan. 1, 1977	Nonpart 36 B-747'3 Jan. 1, 1977	Nonpart 36 standard 4-engine jets Jan. 1, 1977	Cost to retrofit 2-3 engine jets[1] (millions)	Surcharge collections/ entitlements[2] (millions)
AA	235	99	8	85	$37.9	$567.8
BN	86	53	1	11	20.4	163.7
CO	56	32			12.3	160.2
DL	179	80	3	13	24.4	460.2
EA	228	168			57.7	535.4
NA	53	38			14.6	89.4
NW	113	55	17	8	21.1	212.9
PA	114	13		64	5.0	151.5
TW	233	90	10	100	32.8	428.4
UA	364	209	12	100	84.6	651.3
WA	74	29		23	12.8	168.7
FT	19			16		26.4
AL	80	72			23.4	120.6
FL	21	20			9.1	51.2
NC	27	19			5.5	48.3
OZ	28	27			7.8	41.2
PI	20	20			9.1	40.2
RW	37	34			9.9	52.1
SO	28	28			8.2	34.1
TI	22	21			6.0	30.1
HA	8	2			.5	18.1
TS	8	8			3.7	13.1
WC	7	4			1.8	14.3
AS	10	10			3.8	19.1
Total	2,050	1,131	51	420	412.4	4,089.3

[1] Based upon number of nonpart 36 2- and 3-engine jets as of Jan. 1, 1977; times the estimated cost of SAM retrofit of each type in 1981 dollars.

Based upon ATA proposed domestic and international surcharges over a 10-year period beginning Jan. 1, 1977, as follows: Domestic Fares 2%; Domestic Waybills 2%; International Departures $2. Traffic has been estimated to increase at a 5% annual rate. Current fare levels have been assumed for the entire 10-year period.

Source: House Subcommittee on Aviation, Hearings on H.R. 4539 p. 111.

from the special surcharge funds as follows:

Retrofit:	75% of the cost of retrofit
Replacement of engines:	150% of the cost of retrofit
Replacement of aircraft:	250% of the cost of retrofit

As has been mentioned before, there had been a great deal of controversy over whether there should be any rule at all for retrofitting the two and three-engined airplanes on the ground that any modification would be barely, if at all, discernible. There was almost complete agreement that the 4-engine 707's and DC-8's should be replaced in view of their age and fuel inefficiency. Thus, presumably the formula was designed to encourage retirement of these aircrafts and their replacement by newer technology airplanes with high-bypass engines. At first glance the percentages suggest this to be tne case. However, "plugging in" a few practical numbers shows that the incentive was to retrofit rather than to retire. The following "ball park" figures are illustrative.

TABLE 5

APPLICATION OF THE 75%, 150%, AND 250% FORMULA OF H.R. 4539

707 ---- DC-8 (1980 DOLLARS)

	Est.Cost Per Aircraft	Entitlement Formula	Balance to be Raised	% of Cost From Fund
Retrofit	$2,160,000	$1,620,000	$540,000	75%
Replace engines	8,000,000	2,430,000	5,570,000	30%
Replace aircraft)	23,000,000	4,050,000	18,900,000	17.6%
Replace aircraft)	33,000,000	4,050,000	28,960,000	12.3%

It is evident that 250% of retrofit cost for replacement provides less than 20% of replacement cost for medium sized aircraft. Should the replacement be with current wide-bodies DC-10 or L-1011 types or newer technology types in the price range of $30-35 million, the figure would fall to around 12%. The compilation on p. 36 shows United and TWA each had about 100 such planes and American 88. Simple multiplication shows the enormous capital cost of replacement.

It is clear that the formula merely ensured that carriers in weak financial condition would be forced to retrofit and retain their old fleet whereas carriers with independent means, such as Delta and Northwest, to name two, would buy new more efficient aircraft and obtain a competitive advantage. The ATA calculated that the total cost of retrofit for its member airlines was approximately $1 billion as is shown in Table 6. Assuming the formula was so strongly tilted toward SAM retrofit that this was the option used, the ten year collections would bring in $4 billion but retrofit would cost $750 million ($1 billion X 75%), leaving unspent $3.25 billion. The sum would be actually less because those few carriers without financial constraints would replace and use the funds, up to their entitlement, to reduce their cost of their ongoing reequipment program. There was no capacity limit in the bill; it was to come later. The position, therefore, of the carriers and the aircraft manufacturers was that the bill would result in slowing down the retirement process, impede the

TABLE 6

ESTIMATED RETROFIT COST ATA AIRLINE MEMBER FLEET
(Based on U.S. Aircraft Only Being Retrofitted)

Aircraft	Current ATA Fleet Non-Part 36/Part 36 1975	1980 ATA Fleet Non-Part 36/Part 36	Cost Per Ship Set (1980 $) includes Spares (20%) & Labor (6%)	Fleet Capital Cost (1980 $)
DC-9 (all models)	330/7	300/60	$ 273,297	$ 81,989,100
B-737	122/2	121/9	431,520	52,213,920
BAC-111	31/0	27/0	350,000	9,450,000
B-727 100/200	620/136	600/245	195,441	117,264,600
B-707-B100-300	268/0	206/0	2,160,000	444,960,000
B-720-B	18/0	15/0	2,160,000	32,400,000
DC-8 21/31	31/0	23/0	516,432	11,877,936
DC-8 50/61	99/0	74/0	2,323,944	171,971,856
DC-8 62/63	31/0	28/0	1,678,404	46,995,312
B-747 (all models)	51/44	48/75	482,744	23,171,712
Totals	1601/189	1442/389		$992,294,436 1/

ATA Airline Member Fleet Annual Operating Cost Penalties

Added Fuel Cost - FAA forecasts 4,000 barrels a day or 1,424,000 barrels per year 60,808,000 gallons per year at 1980 cost of	$24,140,776
Added Maintenance Cost - B-707 only per year (1980)	3,037,410
Added Annual Operating Cost (1980)	27,178,186

1/ "Down-time cost is not included nor is cost of interest - interest would add 10%.

Source: Hearings on H.R. 4539 House Sub-Committee on Aviation, Committee on Public Works and Transportation, 2/17/76, p. 797.

introduction of new more efficient and quieter aircraft, and fail to respond to the unemployment problem.

3.4 Other Criticisms of H.R. 4539

Unfairness to Pan American: The varying financial position and the status of differing fleet mixes of the carriers made it impossible for the ATA to present a unified position to Congress. Pan American pointed out that it would suffer a competitive disadvantage with its foreign competitors because it would be obligated to raise its fares 2% but its foreign competitors would not. It recommended an addional $2.00 departure tax for all international carriers.

The Cross Subsidy Issue: The bill provided that any excess money not used by a carrier would revert to the Airport and Airway Trust Fund. However, in the event a carrier needed more money than the surcharge would provide, the Secretary of Transportation could dip into the Trust Fund to supply the necessary amount.

This became known as the cross subsidy clause. Delta and Northwest were particularly hostile to this clause on the ground that they, through efficient management, had gone ahead and spent large sums in modernizing their fleets, so that it was unfair to require their passengers to subsidize their competitors. The ATA testified against the cross subsidy subsection. On the other hand, Pan American strongly supported the provision as necessary to provide a "competitive balance of equipment." Using figures found in Table 4, page 56, an Executive Vice President of Pan American argued that under the bill American would have $6.68 million, Braniff $14.8

million, and Delta $35.5 million to replace or modify each plane while PA would have $2.36 million.[15/] The Secretary of Transportation as well as the ATA opposed the cross subsidy provision and it was dropped from the next and all succeeding bills. Pan American's real objection - the fact that the $2 departure tax failed to provide sufficient funds to replace their noisy planes - was later met by increasing the charge to $10.00 for fares of over $100.

3.5 The Administration Position on H.R. 4539

On May 5, 1977, the last day of hearings on H.R. 4539, Secretary Adams in testifying on the bill proposed some very significant changes which, if enacted, would have markedly affected management's decisions on retrofit, re-engining or replacement. Two months earlier, on March 3, 1977, the FAA issued Amendment 36-7 to FAR Part 36 requiring significant noise reductions in newly designed aircraft. The effective date was October 1, 1977. The question raised in the hearings on H.R. 4539 was why should not the financing be structured to encourage the replacement of aircraft by the quietest available planes instead of by those merely meeting the old 1969 standard. Accordingly, the Administration proposal was as follows:

> 35% of replacement cost providing the replacement airplane met the March 3 published standards.
>
> 100% of the cost of re-engining, not to exceed 35% of replacement cost for replacing the plane.
>
> 100% of the cost of retrofit for retrofit.

15/ Hearings on H.R. 4539, House Subcommittee on Aviation, April 21; 1977 p. 466. Testimony of W. W. Waltrip.

If we use the same format as for the H.R. 4539 calculation we have the following:

TABLE 7

APPLICATION OF ADMINISTRATION MAY 5 PROPOSAL

707 ---- DC-8 (1980 DOLLARS)

	Est. Cost per Aircraft	Entitlement Formula	Balance to be Raised	% of Cost from Fund
Retrofit	$2,160,000	$2,160,000	0	100%
Replace engines	8,000,000	8,000,000	0	100%
Replace aircraft)	23,000,000	8,050,000	$14,980,000	35%
Replace aircraft)	33,000,000	11,550,000	21,450,000	35%

Assuming other factors of the bill remained the same, which they did not, the proposal missed the target. Although the amount available for retrofit was increased to 100%, the 100% available for replacing engines was a much larger figure and hence was a greater shift in emphasis toward replacing engines. A carrier with a large number of 4-engine aircraft (100 in the case of TWA) and a weak balance sheet (TWA) out of economic necessity would be forced to choose replacing engines. On the other hand, another carrier with a strong balance sheet and a desire to have the competitive advance of the newest technology aircraft, could opt for a $8 to 11 million discount on the purchase price of a replacement aircraft during the years of surcharge. Another way of putting it is to equate it with a 4-year rollback in inflation. While the hearings were replete with

statements which drew no objection that replacement would result in quieter, more technically efficient planes, particularly in the area of fuel consumption, together with increased employment, and enhancement of U.S. technical superiority, and an aid to the balance of payments problem, the formula in most instances tilted managements' choice to replacing engines or retrofit rather than to replacing aircraft.

Voluntary vs. Mandatory Surcharge: One of Secretary Adams' proposals came as a shock to the industry. He proposed that a carrier could establish a surcharge or not, as it saw fit. Objections from the "have nots" in the industry immediately surfaced, pointing out that since carriers competed with each other, a two-tier pricing system could not survive. If one well-financed carrier chose not to levy a surcharge, all the others would be forced to follow suit or lose business. Thus, the entire financing package would fall apart. Interestingly enough, the press reported that the entire surcharge financing concept as proposed by Adams was opposed by President Carter's staff and the Office of Management and Budget. President Carter while accepting the concept ordered Adams to support only a voluntary surcharge.16/

3.6 Minority View of Bill

The most frequent and articulate opponent of the bill (and of subsequent bills) on the subcommittee was Rep. Gene Snyder (Ky.) who,

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16/ Aviation Daily, May 11, 1977, p. 57.

from time to time, introduced amendments which would have voided the bill. His H.R. 5706 would have solved the problems of law suits over noise and financing aircraft modifications with two quick thrusts: (1) no person would have standing to bring a suit for compensation for damages from aircraft noise if he leased or purchased the property after the airport was established, and (2) no aircraft manufactured before January 1, 1974, would have to comply with the FAA noise rule 91-136, in effect repealing it. Efforts to delete or minimize the application of 2 and 3-engine aircraft from the FAA rule ultimately were unsuccessful. The bill approved October 20, 1977, did include a modified restriction on the right to sue for noise compensation.

D.4 RETROFIT DEEMPHASIZED - H.R. 8124

On the basis of testimony on H.R. 4539, Rep. Anderson on June 30, 1977, introduced a new bill, H.R. 8124, which changed the thrust of financing in significant ways. Briefly, they were as follows:

4.1 Relaxing Compliance Date for 2 and 3-Engine Airplanes

As a result of the considerable testimony that retrofitting the JT8-D 727's, 737's and DC-9's would result in little discernible change to the human ear, the compliance date for these aircraft was extended 7 years to 1990. Since there were 1,131 such aircraft on January 1, 1977, this was over 50% of the entire fleet and over 70% of the non FAR fleet.

4.2 Less emphasis on Retrofit in the Payment Formula

(a) Retrofit: On the ground that retrofitting 4-engined, old, noisy fuel inefficient planes was a waste of resources, the percentage allowance was fixed at 50% as compared with the 75% in H.R. 4539 and the 100% in the Adams proposal. The percentage for the 2 and 3-engined planes constructed before 1/1/74 was 90% unless advantage was taken of the 7-year extension. In that case the figure was 50%.

(b) Re-engine: Here the concept of relating entitlements for re-engining to a percent of the cost of retrofit, as was the case in the previous bill, was replaced by one of the percentage of cost of re-engine with a ceiling limited to the relationship to the cost of replacement. It will be recalled that in March the FAA had issued stricter noise rules (Amendment 36-7) for new planes and the committee was anxious for modifications to use the best technology. Therefore, the provision was for 75% of re-engine costs, provided the aircraft then met Amendment 7, but not to exceed 35% of the cost of replacing the airplane. Here again, a penalty was attached for taking advantage of the 7-year extension. If a carrier waited until after January 1, 1985, it would receive only 25% of re-engine costs.

(c) Replacement: A similar tilt toward using the best technology quickly was used for the replacement percentages. Here also the concept of relating replacement to a percentage of retrofit was abandoned in favor of a relation to the cost of replacement. In general, the amount was 35% of the replacement cost of an aircraft meeting Amendment 7 and 20% for meeting FAR as of January 1, 1977.

For 2-engine airplanes and 727-200's constructed before 1/1/74 and being replaced between 1985 and 1990, the figure was 10% of replacement cost to meet Amendment 7 and 0 to meet FAR 36 January 1, 1977, replacement. One sample calculation gives the following results:

TABLE 8

APPLICATION OF H.R. 8124 FORMULA

707 ---- DC-8 (1980 DOLLARS)

	Est.Cost per Aircraft	Entitlement Formula	Balance To Be Raised	% of Cost from Fund
Retrofit	$2,160,000	$1,080,000	$1,080,000	50%
Replace engines	8,000,000	6,000,000	2,000,000	75%
Replace aircraft	23,000,000	8,050,000	14,950,000	35%
Replace aircraft	33,000,000	11,550,000	21,450,000	35%

The formula portion of the bill was one which the airlines could accept. Although retrofit allowances were reduced, no one, at least of the 4-engined operators, wanted to retrofit anyway. At this time, few airlines looked upon replacing engines as a reasonable alternative, unless they could not get financing for replacing the entire airplane. The replacement percentage of 35% was even 5% higher than the Vice President of American Airlines, Donald Lloyd-Jones, had suggested as an adequate figure.[17] In essence, the cost to the company from its regular sources of income would be

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[17] Hearings on H.R. 4539, p. 507.

rolled back to about the 1975 costs. However, other sections of the new bill presented problems.

4.3 Surcharge Collections

The collections were to be 2% of domestic passenger fares, domestic and international freight waybills, plus a $3.00 international departure tax. The most important surcharge change was that instead of accruing for ten years, it would accrue mandatorily for the first five years and voluntarily for the next five. This was a compromise between the Carter proposal of 10-year voluntary and the ATA 10-year mandatory. As is detailed later, it also was a mechanism to keep Delta and Northwest in support of the bill. Since there was general agreement that the voluntary system would not work, airline managements drew the conclusion that the amount available for assistance was just cut in half.

4.4 Subsequent Sale or Lease of Re-engined or Replacement Airplanes

In deciding whether to retire or re-engine a plane, airline managements were faced with restrictions on selling replacement planes for 15 years, unless they paid back the surcharge in its entirety. A 5-year limitation on selling re-engined planes was established, again unless the surcharges were paid back.

4.5 The Buy American and Equal Capacity Replacement Clauses

A replacement airplane could not be bought with surcharge money

unless over 50% of the airplane price was attributable to the U.S.A. The reason for this was not clear inasmuch as Col. Borman of Eastern who had the A300 under close investigation testified that the over 50% of the price of the A300 was attributable to the U.S.A.

Finally, since replacement airplanes were likely to have a larger capacity than the planes they replaced, some expressed the fear that a wealthy carrier could vastly increase its capacity by buying larger planes. Accordingly, this bill and all subsequent bills limited replacement to 107% of the non-compliant airplane seats and to 107% of non-compliant airplane cargo capacity.

4.6 Summary

As of July, 1977, with H.R. 8124 the airlines and aircraft and engine manufacturers were encouraged that the 2 and 3-engine aircraft might escape retrofit and that considerable incentive had been given to retire the old 707 and DC-8 aircraft. On the other hand, they were concerned that governmentally imposed restrictions on the sale and lease of aircraft might force them to cancel plans to replace. The environmentalists were upset that the majority of the non FAR airplanes which also made the most flights into noise impacted regions, were being let off the hook. The minority, through Rep. Snyder, considered the bill a "rip-off" for the benefit of airlines, bankers, and aircraft manufacturers.

D.5 A Reduction in Financing Benefits - H.R. 8729 Aug. 3, 1977

The optimism which the airlines felt over financing assistance

because of the provisions of H.R. 8124 soon evaporated when a new bill, H.R. 8729, was introduced by Rep. Anderson on August 3, 1977. As a result of pressures from environmentalists and the ranking minority member, the changes contained in H.R. 8729 adversely affected financing benefits in three significant ways.

5.1 Deletion of the 7-Year Extension for 2 and 3-Engine Jets:

Although the extension in H.R. 8124 was for 7 years, the net effect for all practical purposes was presumed to kill the retrofitting of the 2 and 3-engined aircraft. Since Table 4, p. 56, indicates a cost of over $400 million for the SAM retrofit, this amount if deleted could have been applied to help pay for new aircraft and accelerate the retirement of old. However, the new bill reinstated the requirements of the December 23, 1976, FAA rule, thus requiring the expenditure of over $400 million for retrofit. Thus, a reassessment of retirement plans, assumed until H.R. 8124, became a necessity. This change heightened the element of uncertainty in planning.

5.2 Changing of the Base Date for Determining Eligibility for Surcharge Entitlements

Prior to H.R. 8729's introduction, the non-compliant airplanes eligible for financing assistance were those in service January 1, 1977. Under the new bill, the date was moved to July 1, 1977, six months later. During the intervening 6 months, various airlines had made fleet changes toward compliance with the FAR 91-136, effective

January 1. For example, American added 5 new complying aircraft and disposed of a non-complying 707. Delta had 16 changes in its fleet, acquiring nine 727-200's and disposing of 7 non-complying planes. The new date would remove them from application of the formula. Faced with this kind of a possibility, retirement of noisy aircraft would suffer. The incentive would be to maintain the status quo until Congress decided upon a final bill. The very carriers doing the most to bring their fleets into line with the rule were being penalized.

5.3 Reducing the Entitlement Computation Base by the Accrued Depreciation

As noted, the previous formula embodied a figure of 35% of replacement cost if the replacement airplane met the March 3 rule, and 20% if it met the January 1 requirement. Minority members of the House Committee argued that the carriers already had financial benefits from depreciation charges and these should be subtracted from the computation base. Accordingly, the new bill provided that the replacement cost against which the percentage would be applied

> "shall be the actual cost reduced by the aggregate amount allowable under the Internal Revenue Code of 1954 for depreciation or amortization with respect to the aircraft being replaced, for periods before the date of acquisition of the replacement aircraft."

The results of applying this to two assumed replacement prices in the case of early 707 DC-8 aircraft whose constructive purchase price was about $7,100,000 with a current residual of $100,000 is shown on the following table.

TABLE 9

APPLICATION OF DEPRECIATION DEDUCTION AUGUST 3, 1977
VERSION OF H.R. 8729

707 and DC-8 AIRCRAFT

Estimated Replacemcnt Cost	Accrued Depreciation	Base for Formula	From Fund at 35%	Amount To Be Raised Privately	Reduction from H.R. 8124
$23,000,000	$7,000,000	$16,000,000	$5,600,000	$17,400,000	$2,450,000
33,000,000	7,000,000	26,000,000	9,100,000	23,900,000	2,450,000

These figures show a reduction in financing assistance by $2.5 millions per plane. Although there was a rationale behind the theory of the deduction, as a practical fact, its application not only reduced the funds available to below the desired goal but also penalized the carriers with aggressive fleet replacement plans in operation. Delta estimated the adverse effect to be $100 million.

Some carriers, such as Delta and Northwest, had depreciated planes for tax purposes as quickly as possible for cash flow purposes. For the early planes, the rate was 7 years on the double declining balance (DDB) method and, under current rules, on a 9-1/2 year DDB. At the other end of the scale were those using the CAB standard of 14 years for turbofans or 16 years for widebodies to enhance reported earnings under the new bill. Utilizing the double declining balance on a 7-year basis would entail 4 times the penalty for such a carrier, and at the end of 7 years the penalty would still be double that for those carriers using maximum life. In private conversations, the carriers referred to

this as "the big wipe-out."

5.4 Other Provisions

Slightly offsetting the effect of reintroducing compliance by 2 and 3-engine aircraft was a "safety valve" provision which permitted the Secretary of Transportation to waive the application of the regulations to such aircraft for such time as seemed reasonable. No standards were set up for the Secretary's guidance. The most likely potential use of the waiver involved certain 4-engined craft on which manufacturers might drag their feet on building retrofit kits. Conceivably in a certain economic situation with an amenable Secretary of Transportation, the whole retrofit program could be voided.

On the complaint of Pan American that the surcharges were inadequate for international operations, two increases were provided. One, the 2% property surcharge was changed to 5%, and, two, the $3.00 U.S. Departure Tax was changed to $10.00 on fares of $100 or more and $2.00 on fares of less than $100.

A benefit to the carriers was included by eliminating the funds received from inclusion in gross income under the Internal Revenue code. This was to draw continuous criticism from the Treasury and Representative Snyder.

Finally, the bill contained a Title IV which could be read to be in opposition to Federal preemption. This was a direct blow to the ATA contention that for uniformity Federal preemption was a must.

Given the strength and politics of those who considered the whole financing arrangement as special interest legislation, all that would be needed to defeat the bill would be for several airlines to turn against it using as a reason favoritism to selected inefficient carriers. Thus the price of support from carriers such as Delta and Northwest was satisfying their complaint that they were being discriminated against. One of their complaints is illustrated by Table 10.

The table shows that Delta would have to return $48 million of its charges to the trust fund, Eastern $188 million, Northwest $67 million, National $20 million, and Continental $40 million. All the other trunks were eligible to use far more than their collections.

Secretary Adams was sympathetic to some of the carrier complaints and urged an increase in the percentages for replacement as partial compensation for the depreciation deduction. He also recommended a 100% coverage for retrofit. The depreciation deduction he found "counterproductive" and the 15-year restriction on selling replacement aircraft and the 5-year restriction for re-engined aircraft "unnecessarily restrictive." Additionally, he favored eliminating the "buy American" provision for fear of international retaliation. On the other hand, he again reiterated the Carter position that the whole surcharge plan should be voluntary. Finally, he indicated that the $10 international rate for Pan American was "excessive and inflationary."

D.6 RESTORING LOST BENEFITS BY SUBCOMMITTEE AND FULL COMMITTEE

To recapitulate, after several years of hearings emphasizing the desirability of replacement over retrofit, the first draft of the Airport and Aircraft Noise Reduction Act, H.R. 4539, contained incentives for retrofit rather than replacement. Secretary Adams proposed a marked shift to replacement as did the subsequent bill H.R. 8124. Within a month, H.R. 8124 was superseded by H.R. 8729 which again reversed course in providing benefits and introduced a provision said to be discriminatory against efficient self-sufficient carriers. As a result, the adversely affected parties marshalled their Washington forces to correct the inequities.

Earlier in this report, we alluded to the initial lack of enthusiasm for any financing bill by financially strong carriers who had engaged in equipment modernization programs meeting FAA noise requirements. Originally, they objected first to helping the weaker lines, apparently preferring to see them eventually "go down the tube." Secondly, they most strenously objected to any cross subsidy features in which their passengers would be taxed to preserve the existence of less efficient competitors. The ATA had a most difficult time in developing a position upon which all carriers could agree. It was only when the cross subsidy was dropped and Delta and Northwest found that they too could enhance their ongoing programs through using the surcharge funds that they became not only willing but aggressive parties in favor of financing legislation.

TABLE 10

COMPARISON OF SURCHARGE COLLECTIONS AND ENTITLEMENTS
UNDER H.R. 8729 AND PROPOSED MODIFICATIONS
TO ALL ATA MEMBER CARRIERS
(Millions of Dollars)

AIRLINES	SURCHARGE COLLECTIONS 1/	ENTITLEMENTS UNDER HR 8729	ENTITLEMENTS UNDER PROPOSED MOD.
AA	315	524	630
BN	94	117	144
CO	59	17	21
DL	247	199	227
EA	335	147	206
NA	50	30	40
NW	127	60	104
PA	312	517	598
TW	258	622	724
UA	288	773	947
WA	84	115	130
AL	49	20	20
FL	21	8	8
NC	20	5	5
OZ	17	6	6
PI	16	8	8
RW	22	8	8
SO	15	7	7
TI	13	5	5
FT	55	90	90
AS	7	18	27
WC	6	2	2
HA	8	1	1
TS	5	3	3
TOTALS	2423	3302	3961

1/ Assuming 5 year domestic/10 year international surcharges, under HR 8729. Proposed modification have no substantial effect on collected amounts.

Source: ATA

A markup session for the subcommittee to amend the bill was held on September 20 but the proceedings were blocked by Rep. Gene Snyder using a parliamentary technicality. His real complaint was that he had a commitment from the chairman of the full committee, Harold Johnson, which had been broken that the bill would: (1) prevent the use of federal funds for replacing planes which would be retired before January 1, 1985 (the noise compliance date); (2) provide that the funds would be proportionate to the useful remaining life of the replaced plane; and (3) explicitly prohibit banks or financial institutions from receiving any benefits under the bill. However, the markup did take place three days later on September 23.

6.1 Subcommittee Amendments of September 23 - Enhancing Replacement and Re-engining

The amendments can be summarized as follows.

6.1.1 The Formula. After the committee amendments, [18] the financing formula was as follows:

Retrofit	90% for 2 and 3-engined planes 50% for 4-engined planes:
Re-engine	75% of cost of re-engining not to exceed 40% of the cost of replacement
Replacement	35% of replacement cost for March 3 standards 25% of replacement cost for January 1 standards Prior to applying the above percentages, the replacement cost would be reduced by the excess, if any, of depreciation over the amount treated as ordinary income in the disposition of the replaced aircraft.

[18] H.R. 8729 showing amendment adopted by the Subcommittee on Aviation [Committee Print] September 27, 1977

The retrofit formula represented no change from the June and August bills. The re-engining figure of 40% involved a 5% increase from previous bills and actually provided a greater dollar benefit than the 35% for replacement. The difference was more than 5% of the cost of replacement average because in the case of replacement the depreciation deduction was taken from the replacement cost before applying the percentage. Since re-engining was 1/3 to 1/2 the cost of replacement, the balance to be raised would be much smaller.

6.1.2 Eligibility Date: Moved to January 24, 1977, from July 1. Each airline has its own special problems and when a few have the same problem they can combine to seek a consensus. The propect of success is enhanced if what they seek does not hurt another carrier and has a rational basis. Moving the date to January 24 (the true effective date of the December 23 order) benefitted the industry, according to figures compiled by ATA, by $41,200,000. As indicated in Table 11 below, the amounts varied widely among selected carriers.

TABLE 11

EFFECT OF DATE CHANGE ON SELECTED CARRIERS

American	$8,000,000
North Central	8,000,000
Pan Am	4,300,000
Flying Tiger	5,000,000
Western	5,000,000
Braniff	3,000,000
Continental	100,000
TWA	100,000
National	0
United	0

If one assumes a $23,000,000 new technology replacement airplane requires 4 years from date of order to significant deliveries and that the manufacturer requires 30% down by date of delivery with payments to begin at once and be amortized evenly, the $8,000,000 made available by the date change could provide one year's progress payments on 4 aircraft which would involve the ultimate retirement of more than 4 aircraft. Thus, this date change was not insignificant.

6.1.3 The Depreciation Offset. Delta and Northwest strongly argued that the depreciation deduction was a blow against efficient operators using conservative financial practices such as DDB. The greater the depreciation the bigger the deduction from their cost basis before applying the formula percentage figure for replacement money. Thus their incentive for retirement was decreased while the incentive for re-engining would be increased. Since the sale of a used aircraft over book value is an indication that depreciation is excessive and since the amount is treated as ordinary income and so taxed, they argued that the deduction for depreciation should be offset by the amount realized as ordinary income on a sale. Both Delta and Northwest have been very successful in disposing of old aircraft with little or no value on the books for prices close to or exceeding their original purchase price. In these cases applying the offset completely eliminates the deduction so that the carriers would be back to the benefits under the old H.R. 8124. (See Table 8.)

Not only was this type of offset important for retiring old relatively cheap (by current standards) planes but also for newer more expensive types. For example, suppose a carrier having three noncomplying 747's costing about $22 million each contracted to sell them for a total of $43 million after three years of ownership. Having used depreciation on the double declining balance method, $36 million in depreciation would have to be deducted under the first version of H.R. 8729. This would be $12 million per plane

from a replacement figure using our standard $33 million assumed replacement cost. Thus the money available from the fund would be $7.35 million for each plane [($33M-12M) X 35%]. Assuming the sale price of $14.3 million each the deduction would now be $7.7 million so that the fund could supply financing assistance of $8.9 million. Thus the September amendment added $3.6 million financing assistance on this particular transaction.

6.1.4 Replacement Percentages. Since the 35% figure was retained for aircraft meeting the March 3 standards while the 20% for the old standards of Jan. 1 was increased to 25%, once again it appeared that a step backward was taken from increasing the incentive for replacement. As has been just pointed out, with a re-engine limit of 40% of replacement cost and only a 35% limit for replacing the entire aircraft the total dollars required for replacment were very much more than for re-engining. Considering capital constraints this split would cause carriers to take a very close look at re-engining which would, of course, have an adverse effect upon retirement of aircraft.

6.1.5 Other Changes Made by the September Amendments.

Several other changes of interest to us were made.

1. Improving the domestic market for 2 and 3-engine noncomplying used aircraft. Some carriers cannot afford to purchase new aircraft and often there are no new aircraft of the correct size available. If carriers were to purchase noncomplying aircraft after Jan.1 1977 they would be ineligible for surcharge funds for retroft. The ATA

proposed that these carriers have access to the same financing mechanism as the original operators. The ATA suggestion was adopted including a recommendation, the reason for which is not clear, that the replacement entitlement of the original operator should then be reduced by the amount of the retrofit entitlement. This reduction was criticised by the Secretary as an attempt to cure an inequity which did not exist. He also argued that the new provision added an undeserved penalty on the selling carrier.19/

2. Elimination of Title IV: Title IV had weakened the airlines' position with regard to federal preemption. Its elimination was gratifying to the industry.

3. Reduction of period within which a carrier could not sell its replacement airplane without losing a portion of surcharge funds used to purchase the aircraft. The former figure of 15 years was reduced to 5 thus restoring to management some degree of flexibility in decision making and giving management an opportunity to change equipment with changing condtions.

4. "Buy America": This provision was deleted, thus reducing problems with foreign manufacturers.

5. Guidelines for granting waivers of compliance. As previously noted, an early bill gave the Secretary very broad powers to grant waivers of compliance with no guidelines. The new provision

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19/ October 19, 1977, letter from Secretary Adams to Chairman of Committee on Public Works and Transportation, House of Representatives, p. 2-3.

required a finding of "good cause" which was defined as: (1) a case where the supplier could not furnish in timely manner the necessary engine retrofit kits, replacement engines, or replacement aircraft; (2) any case where the operator could not obtain financing at reasonable rates; (3) any case where compliance would result in the inability to operate the aircraft so that service to the public would end; and (4) any other circumstances the Secretary deemed appropriate.

6.2 DOT Position: Further Increase in Entitlements Desirable

The final opportunity for those for and against financing assistance to affect the legislation to go before the House came at the full committee markup Oct. 20. The administration in general favored the airline view and made the following points and suggestions in a letter to Chairman Johnson.20/

6.2.1 Formula: Replacement Vs. Re-engining. The change increasing the percentage for Jan. 1 standards to 25% while at the same time keeping the replacement percentage at 35% and increasing the re-engine figure to 40% exacerbated the basic problem with the section which was its failure to provide sufficient incentive to purchase new quieter designs. Financially it was to the distinct advantage of the carriers to buy older designs. The Secretary recommended that no funds be provided for replacing with Jan. 1 noise rule aircraft.

20/ Letter, Brock Adams to Chairman Harold T. Johnson dated Oct. 19, 1977

6.2.2 Cost Reduction for Depreciation. The Secretary argued that while the offset amendment modified the extreme penalty of the depreciation deduction, the result would still be to discourage replacement of older noisy aircraft. The depreciation reduction provision, he said, should be deleted. Of course, such a deletion would have to contend with strong opposition from Rep. Gene Snyder for whose benefit the provision was inserted.

6.2.3 International Concerns. Little attention had been paid to foreign carriers who under the bill would be required to levy the surcharge but could not use the revenues to purchase new aircraft or modify old ones. The inequity could be corrected by turning the money over to the foreign carrier. However, this would be a $1/2 billion going to foreign carriers without benefit to American carriers. The Secretary reiterated his September complaint that the $10 surcharge was excessive.

6.2.4 Excessive Powers Given to the Secretary. The most serious objection to the Sept. 23 version was the broadness of the standards by which the Secretary would judge applications for exemptions. "They are so broad that airlines unwilling to comply with the regulations could by their own market decisions force a situation where the Secretary would have little choice but to grant exemptions."

Finally, he pointed out that the requirement that the Secretary establish allowable costs of retrofiting, re-enginging and replacement

placed a heavy duty upon him with which he was not equipped to cope. He could have gone further and pointed out that the Secretary would be under great political pressure from the airlines and manufacturers to pick figures favorable to them with the consequent allegations of "deals."

6.3 H.R. 8729 FINAL AMENDMENTS OCT. 20, 1977, FULL COMMITTEE

6.3.1 The Increase of the Replacement Percentage to 40%. As a result of various pressures the full committee approved an amendment increasing the replacement percentage to 40% which did two things, namely, (1) eliminate the inequity of the September amendment under which a carrier could receive significantly more to re-engine at 40% of replacement and no deduction for depreciation than for replacement; and (2) increase the actual dollar entitlement for replacement. Table 12 shows the collections and entitlements estimated by ATA for member airlines for both the 35% figure and 40%.

While entitlements of in the neighborhood of $600 million for American and Pan American, $700 million for TWA and $900 million for UAL made satisfactory reading for the respective airline managements and their lenders, the availability of such funds through the surcharges was another matter. The original bill contained surcharge accruals for a 10 year period and was estimated to produce about $4 billion - the amount estimated by the ATA to be required in the final bill. However the compromise of 5 years mandatory and another 5 voluntary cut ATA's estimate down to $2.4 billion. An

TABLE 12

ESTIMATED IMPACT OF MODIFIED
NOISE BILL
(MILLIONS OF DOLLARS)

Airline	Collections 1/	Entitlements 2/	Entitlements 4/
AA	315	547	607
BN	94	126	134
CO	59	19	19
DL	247	275	298
EA	335	176	176
NA	50	35	35
NW	127	135	142
PA	312	522	593
TW	258	634	712
UA	288	821	899
WA	84	115	130
FT	55	90	90
AL	49	20 3/	20 3/
FL	21	8	8
NC	20	5	5
OZ	17	6	6
PI	16	8	8
RW	22	8	8
SO	15	7	7
TI	13	5	5
AS	7	3	3
WC	6	2	2
HA	8	1	1
TS	5	3	3
Totals	2423	3571	3911

Notes: 1/ Assumes 5 year domestic / 10 year international surcharge collections.

2/ Provides entitlements of 25% for Part 36 and 35% for Part 36-7 aircraft; also provides for depreciation recapture.

3/ Assumes that carriers would exercise the retrofit option. Should they elect to replace non-complying aircraft, their entitlements would be greater.

4/ Provides entitlements of 25% for Part 36 and 40% for Part 36-7 aircraft, also provides for depreciation recapture.

Source: ATA

C-9

effort to restore the 10 year failed in the markup session as did a compromise effort of 7 years.

On an individual aircraft basis, using our same assumptions of possible replacement costs at either $23 million or $33 million and depreciation offset completely by depreciation recapture on sale, the 40% number develops a $9.2 million entitlement as compared with the previous $8.05 million for the $23 million replacement. And for the $33 million larger aircraft the resulting figure is $13.2 million or a $1.6 million increase. A recapitulation from the first bill to the one committed to the whole House on Dec. 13, 1977, follows.

TABLE 13

SUMMARY FOR 707/DC-8 AIRCRAFT REPLACEMENT ENTITLEMENTS

Bill or Proposal	Entitlements (in millions of dollars) $23 Million Aircraft	$33 Million Aircraft
H.R. 4359, Mar. 7, 1977	$4.050	$4.050
Administration, May 5	8.050	11.550
H.R. 8124, June 30	8.050	11.550
H.R. 8729, Aug. 3	5.6	9.100
H.R. 8729, Sept. 23*	8.050	11.550
H.R. 8729, Oct. 20	9.2	13.2

*Assuming old aircraft show maximum depreciation on the books.
Note: The figures for Aug. 3, Sept. 23, and Dec. 13 are maximums. Should the depreciation and depreciation "recapture" be different than assumed, the entitlements would have to be adjusted accordingly.

Although within the ATA there was a problem of presenting a united front (at one time or another Delta, Northwest, Continental, National and even Eastern seemed ready to break ranks), the figures in the table which in March began with a $4.05 million maximum entitlement ended up in October at $9.2 and $13 million. This would indicate that up to this point the ATA lobby was very successful. Of course, the ATA had a broad spectrum of supporters in its efforts. First were the aircraft and engine manufacturers. However, because of differences among the airlines the latter's role was less visible. Manufacturers are very skittish about alienating customers. Obviously their interest was replacement by new design airplanes and their testimony did not understate the difficulties or disadvantages of retrofit and re-engining. Given the unemployment problem in the country, the labor unions were solidly on the side of financing assistance with replacement being the desired mode. Understandably, the investment community strongly supported financial assistance in order to strengthen their customers, both the airlines and the manufacturers.

Additionally the bill was strongly supported by the environmentalists providing the 2 and 3-engine airplanes would not escape the timetable in the noise rule. Finally support came from many municipal authorities because of their hope for federal assistance with the noise problem.

6.3.2 Foreign Carriers Made Eligible for Surcharge Fund.

Foreign air carriers have relatively the same number of jet aircraft as the U.S. carriers, i.e., 2000. Of these 2000 about 400 not meeting Jan. 1, 1977, FAR 36 standards fly into the United States. Because of their longer range with the extra fuel loads required, these 400 tend to create higher noise levels. 21/ Their retirement or modification would be looked upon with favor by the public and the aircraft manufacturers. In the debates much was said of the international problem of unilaterally taking an action. However, the committee recognized the inequity of making demands on and giving benefits to U.S. operators and not to foreign. It developed that in certain foreign countries there were already such things as a noise head tax which U.S. passengers paid.

The Committee passed an amendment which provided that the foreign carriers would be required to collect the surcharges applicable to international flights and could obtain a portion or all of the surcharges back as soon as its entire fleet operating in the United States meets part 36. To a certain extent this is discriminatory against domestic carriers. First, foreign carriers do not have a phased timetable as do U.S. carriers. Foreign carriers do not have to comply until 1985. Secondly, it is possible under the wording for a foreign carrier to receive 100% of replacement, re-engine or retrofit cost. This is true because of the provision that

21/ 95th Cong. 1st Session, House Report No. 95-836, Airport and Aircraft Noise Reduction Act, Dec. 13, 1977, p.12.

when all the aircraft meet FAR 36 and are so certified as to the cost the Secretary is required to return an amount equal to the certified expenses, but not to exceed the amount collected by the operator.

D.7 SUMMARY OF TITLE III AS ADOPTED BY FULL COMMITTEE

As adopted by the full Committee on Public Works and Transportation of the House of Representatives on October 20 and reported December 13, 1977, Title III of the proposed Airport and Aircraft Noise Reduction Act, H.R.8729 may be summarized as follows.

1. The Secretary of Transportation will publish the list of commercial jet aircraft weighing over 75,000 lbs. which were in for-hire service on Jan. 24, 1977, and which did not meet the FAA noise regulations promulgated Dec. 23, 1976, to be effective Jan. 1, 1977.

2. Within 30 days the operator must advise the Secretary that he will comply with the rule and specify the means chosen: (1)retrofit, (2)replace engines, or (3)replace airplane.

3. To provide funds to support this program each domestic operator is required to impose a 2% surcharge on his before tax passenger and cargo tariffs. International cargo requires a 5% surcharge. International passenger surcharge is $10 for fares of $100 or more, and $2 for lesser international fares.

4. In the case of U.S. carriers the funds are deposited into individual trust accounts to be withdrawn as needed under terms of a formula. In the case of foreign carriers the surcharges go into one fund and may be utilized only upon certification that all the operator's aircraft operating into the U.S. comply with the rule. 1985 is the final limiting date.

5. Domestic surcharges are mandatory for the first 5 years and voluntary for the next five. International surcharges are mandatory for 10 years.

6. Surcharges in the accounts may be withdrawn for the sole purpose of noise abatement. The "Entitlements" for withdrawal are calculated by a formula intended to provide an incentive to replace noncompliant aircraft with compliant aircraft, preferably new technology aircraft meeting the stricter FAA rule published March 3, 1977.

Entitlement Formula

A. Retrofit:	2 & 3 engines: 90% of retrofit cost 4 engines: 50% of retrofit cost
B. Replacing engines:	75% of the cost of replacing engines but not to exceed 40% of the cost of a replacement plane meeting the March 3 rule
C. Replacing the aircraft:	40% of cost of replacement if the aircraft meets the Mar. 3 rule 25% if meeting the Jan. 1 rule Before applying the above percentages, depreciation minus the ordinary income recovered on sale must be deducted. Noncomplying aircraft can be sold with the buyer making the modification with his entitlement and the seller losing an equivalent amount. Leasing of replacement aircraft is restricted to leasing to another air carrier for 5 years. If a replacement aircraft is sold within 5 years, a prorate of the used entitlement goes to the Treasury. Replacement payments are limited to covering no more than 107% of seats of noncomplying aircraft. 107% also established for replacing dedicated cargo capacity.

7. Surcharges are not to be considered as gross income for Internal Revenue purposes.

8. No cross subsidy. Excess surcharges above entitlements will go via the Treasury to the Airport and Airway Trust Fund.

9. The Secretary, through the FAA Administrator, may waive application of the regulations upon application by operator who shows "good faith" and there is "good cause" for failure to comply. The good cause is further defined as: (1)inability to obtain SAM kits, replacement engines, or replacement airplanes; (2)inability to obtain financing "at reasonable rates"; (3)inability to maintain scheduled service to the public; (4)"any other circumstances the Secretary deems appropriate."

7.1 Impact on the Federal Budget

Precise quantification of the effect of Title III on the Federal Budget is not possible. The revenue side, consisting primarily of aggregating passenger revenues of each carrier and projecting them forward for five years combining an assumed traffic growth factor and a tariff escalation factor, is less complicated than estimating the cost side. The latter involves replacement assumptions versus re-engine versus retrofit decisions using aircraft much of which is not yet designed and whose economic effects are under constant evaluation. The changing economic fortunes of the carriers which can be heavily influenced by route awards, by regulatory reform as well as by technological progress, widen the forecast bands of possibilities. With this caveat we present the estimates furnished to the legislators.

Assuming the 5-year mandatory period the Congressional Budget Office estimated that the surcharge "may result in excess revenue of approximately $100 million."22/ Such a statistic will not be forgotten by those pushing for the bill's passage. In view of the fact that the FAA has estimated that the surcharges would produce $2.5 billion for U.S. Flag carriers, and that the ATA has estimated the entitlements to be about $4 billion, a word of explanation is in order. Simply stated, no carrier can withdraw more than its own surcharges no matter what the cost or entitlements are, whereas carriers whose surcharges exceed their entitlements must refund the

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22/ Ibid. p. 25

difference to the Treasury. In today's real world what this means is that some of the neediest carriers, TWA for example, will receive relatively less to meet their requirements than some more affluent carriers. The elimination of the cross subsidy provision was the initial obvious cause of this situation.

However, the deeper explanation demonstrates the interaction of economic and political power. Considering the problem and the ultimate objective ATA had in keeping its members behind the bill, perhaps Anwar Sadat and Menahem Begin could consult the ATA on composing conflicts. Key sections of the bill are the result of successful maneuvering by Delta and Northwest whose support was absolutely essential. Profitable Northwest, led by President and Chairman Donald Nyrop, one of the last of the rugged individualists, was almost paranoid about permitting any money collected from his passengers going to support equipment purchases by any of his competitors whose plight he openly stated was due to incompetent management. Even more profitable Delta also felt that any use of its surcharges to weaken the competitive advantage it had carved out for itself was government intervention in private business of the worst sort. They made it quite clear that they were in a position to blow the bill out of the water unless two primary demands were met.

The first demand was that no carrier's surcharges be used by any other carrier. The second demand was that regardless of how the rest of the carriers were affected these two carriers would have

to be able to use all their surcharge money. They did not wish to refund anything to the Treasury. The original bill, it will be recalled, called for a 10-year accrual and would have provided over $4 billion. In the breakdown of entitlements this would have provided Northwest and Delta with almost twice as much as they could use. Thus the 5-year figure not only was a compromise with the administration's position of voluntary surcharges for 10 years but handily fit Northwest and Delta's requirements. In meeting these demands many other carriers had to sacrifice significant benefits. However, when faced with the choice of significant benefits, though inadequate, or no benefits, the other carriers, with the sword of Damocles hanging over their heads, felt they had no choice.

7.2 The Minority View

As has been suggested early in this section, the opponents to the bill were articulately represented by Rep. Gene Snyder of Kentucky who consistently objected not only to specific provisions but also to the philosophical basis of the legislation. His position is outlined in a minority report.23/

23/ Ibid. pp. 33-36.

In assessing the effects of Title III of the bill on the retirement of transport jet aircraft one must consider the possibilities of the successful progress of the bill through Congress and its ultimate approval by the President. The proponents of legislation often become overconvinced of the success of their project merely by rereading their own material. Therefore, it seems appropriate to highlight the objections of both those with a simple lack of enthusiasm and those who in less formal conversation use terms as "ripoff," "subsidy," or "wonderful gimmick." The contra opinions covered in the minority report may be summarized as follows.

Three signers of the report (Reps. Snyder, Ambro, and Goldwater) considered retrofitting a waste of money which should be spent on new technology aircraft, and at the final markup Rep. Snyder unsuccessfully again tried to repeal the FAA Amendment 91-136 of Dec. 23, 1976, which would have voided the retrofit requirement.

The minority report also commented that since FAR 91-136 did not have to be fully complied with until Jan. 1, 1985, "There is no sane justification for giving owners or operators of aircraft financial assistance for replacing their equipment which will be totally depreciated and out of use prior to Jan. 1, 1985.."[24/] In regard to replacement, some of the minority felt that even the depreciation deduction was not enough to take away from replacement cost. It was argued that the percentage of life left in the old aircraft on Jan. 1, 1985, if any, should be the percentage of cost

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24/ Ibid. p. 34

of new replacement aircraft on which the 40% "subsidy" is computed. This would result in a de minimis amount.

Rep. Ambro commented that the replacement formula of 25% for the Jan. 1 rule and 40% for the Mar. 3 rule still did not provide enough incentive for new technology. However, his proposal was not to increase the 40% but to decrease the 25% to 20%. This was opposite to the concern expressed by some in Boeing who felt that the 40% to 25% spread was already too large to the detriment of some of their current technology aircraft sales potential. As an example, it was calculated that from their point of view a 10% spread was already a $1.3 million penalty on a 727 price.

Rep. Ambro also pointed out that the 5-year mandatory and 5-year voluntary surcharge was deficient for two reasons. First a 10-year period as provided in the original bill was needed to collect the estimated needed sum of $4 billion. The 5-year mandatory period cut the amount collected in half. Secondly, the competitive pressures within the industry would ensure that the 5-year voluntary period would never be utilized; thus the objective of the program would never be realized. We have already discussed the economic and political pressures which gave rise to this provision.

The minority report also expressed disappointment with the waiver provisions which seemed to contain broad economic loopholes for airlines not disposed to investing in noise control. It could well have added that whatever may be said on the merits of a series of limitations on the Secretary's power, the addition of the clause

"Any other circumstances the Secretary deems appropriate" opens wide the door of possible abuses.

D.8 SUMMARY AND CONCLUSIONS

The development of the jet transport in the 1950's and their introduction in significant numbers in the early 1960's represented a quantum jump for the industry. The coupling of larger size with an almost doubling of speed accompanied by more economical operation laid the basis for an increasing volume of flights. Unfortunately for society the first jets were exceedingly noisy. Although the introduction of the turbofan represented some improvement in the noise level, the sheer increase in number of operations more than compensated for the difference.

In 1969, bowing to public pressure, the FAA promulgated FAR Part 36 which provided that any newly designed certificated plane must have a significantly lower level of noise emissions. Later in 1973 the rules were tightened to include any currently produced plane coming off the production. This left 75% of the existing jet fleet uncovered by the regulations. In descending order of noise emissions were (1) the early pure jet 707's and DC-8's, (2) the turbofan 707 and DC-8's, and finally (3) the 2- and 3-engined turbofan jets such as the 727, 737, and DC-9 series.

Homeowners, school operators, and others located near airports continued their pressure for noise relief insisting that the noise rule be extended to cover the remaining 75% of jet transport aircraft. If previous history is to be used as a guide, often a dangerous assumption, many in the 707 and DC-8 fleets were on the point or beyond the time of their expected retirement from their first purchaser. Indeed they were approaching what had originally been assumed by many to be their design life.

However at this time the airlines were suffering a period of reduced and, in some cases, negative earnings. Their position was that private financing to handle noise compliance expenses was just not available. The next section covers the financial perspective in more detail.

As a result of extensive public hearings and many private discussions in November 1976 Secretary Coleman issued a policy statement

indicating that the FAA would shortly publish a rule requiring the noisy planes to meet the 1969 rule over a period of time either by retrofitting, replacing engines, or retiring the aircraft. Such a rule was issued December 23, 1976. Although there was spread on the record a commitment by the FAA not to promulgate such a rule without a financing plan, the rule was so promulgated and initially the administration argued that the passage of a deregulation bill would improve the carriers' economic position sufficiently that financing would not be a problem. The airlines felt betrayed and immediately took their case to Congress.

The foregoing section depicted the ebb and flow of the battle between the airport neighbors and the airlines over the timing, method, and financing of the noise abatement. After first considering and rejecting the idea of refusing to take any steps toward compliance so as to face the government with a "fait accompli" and daring it to ground the aircraft, the ATA sought to support that part of broad noise control bills which would assist in the financing of either retrofit, replacing engines, or retiring the planes. Their strong preference was for retiring current planes and replacing them with quieter more fuel efficient airplanes. In this they were supported by the labor movement which saw more jobs, and by the aerospace industry which saw the need for keeping technology moving as well as the relative effect on the bottom line of their operations.

In tracing through the various versions of bills H.R. 4539, 8124, and 8729 one develops a deeper understanding of the problem of uncertainty facing airline managements making equipment decisions. Those managements under severe financial constraints must know the implications of their decisions. A decision made on the assumption that H.R. 4539 with its emphasis on retrofit would pass would have been most unwise if H.R. 8124 with its elimination of the 2- and 3-engined aircraft from compliance were enacted. Similarly at one stage H.R. 8729 had a higher percentage going to re-engining than replacement, and replacement was reduced by depreciation. Accordingly, any carrier in extremely tight financial condition would have been forced to consider quite seriously re-engining some very old planes when retirement was the desired course. Although H.R. 8729 as reported out by the full committee December 13, 1977, seems to be reasonably satisfactory to the airlines, the fact that it has not been to the Ways and Means Committee much less the Senate, indicates that it has a long way to go. Therefore, one must give much credence to the views voiced by many airline equipment decision makers that they will do nothing significant until they know the final outcome of the noise financing legislation.

However sincere these statements have been, changing conditions cast a cloud over their continued validity for some carriers. The overcast of financial impossibility has been replaced if not by broken clouds at least by rays of sunshine. The change in direction of profitability has wrought significant changes in the attitudes of

certain carriers. Secondly, the overcapacity with which the industry was plagued has all but disappeared for some so that playing a waiting game might put them at a competitive disadvantage. Finally, one situation which made it easier to say, "We won't move a muscle until a financing bill is passed," is changing. This situation is the availability of a "better mousetrap" as a replacement airplane.

Over the past several years overcapacity and the absence of an economic new technology or derivative plane between the size of a wide-body and a 707 or DC-8 which also met the new more stringent noise standards was given as a further reason for not retiring the older planes. As traffic surged in 1977 some airlines became less certain that the DC-10, L1011 and the A300 were too large. Further, intensive development by Boeing and McDonnell-Douglas of derivatives and new technology models has been slowly but surely sapping the nonavailability argument of validity. Finally, the need for more aircraft due to growth plus more interest on the part of lenders in providing funds and the strong financial condition of several carriers may whet the appetite of these carriers to participate in launching a new type aircraft.

Notwithstanding these latter developments, one can safely conclude that uncertainty concerning federal legislation over financing assistance for retrofit, re-engining or replacement is the primary factor adversely affecting the retirement of our old jet transport aircraft.

E.

FACTORS IN JET AIRCRAFT RETIREMENT: TECHNOLOGICAL AND ECONOMIC PERSPECTIVES

The conclusion reached in this section is that for current jet aircraft "age" per se, whether it be measured by the passage of time, the number of hours the aircraft is in service, the number of "cycles" (either pressurization, or landing) is not a factor in the forseeable future leading to their retirement. The reasons for this conclusion follow.

E.1. AGE IN YEARS

The conventional view is that machines wear out with use. Provision for this is made by depreciating the machine over its useful life. We have seen that in the prejet era, aircraft were retired on the average after seven to ten years of service which did not match their depreciation periods. It was anticipated that the more costly jets would have a longer service life than the preceding technology and thus spread the capital costs over more units of service. When, about ten years later, more efficient wide-bodied aircraft were designed, the annual traffic growth was approximately 15%. With this demand it appeared that the cycle of seven to ten years would repeat itself, at least, for trunk carriers. However, the slowing of traffic growth accompanied by financial adversity which was intensified by the rapid increase in fuel prices adversely affected the need for more capacity and inhibited the purchase of new, more efficient replacement aircraft if such were available.

As the advisability or necessity of keeping current fleets operating grew, attention turned to examining the question of to what length and at what cost could aircraft lives be extended. The following table shows the Fleet Age Distribution of U.S. Trunk lines. From the standpoint of chronological age alone, 75 commercial jets exceed 16 years of age and 487 are over ten years old.

TABLE 14

SYSTEM TRUNK AIRLINE
SCHEDULED FLEET AGE DISTRIBUTION
(1976)

Years in Service	Number of Aircraft
18	3
17	27
16	48
15	--
14	17
13	67
12	87
11	91
10	147
9	160
8	304
7	152
6	90
5	65
4	88
3	110
2	75
1	65

Source: Robert R. Ross, Commercial Jet Replacement Process, MST Thesis, Transportation Center, Northwestern University, 1976

Engineering investigations and experience by the operators reveals that aside from some corrosion around the windows and in the

floors and underbody of the aircraft, the passage of time alone does not cause significant deterioration of the aircraft. Maintenance "fixes" have been able to correct for the corrosion. Appendix A indicates that the current jet fleet was introduced into service in 1958, about 29 years ago. Since 19 years have elapsed without significant degradation, time itself is not a concern within the period of this study.

E.2 AGE IN HOURS AND CYCLES

In the prejet era, a convention arose to discuss airplane life in terms of hours flown. Until the introduction of the four-engine pressurized craft, the stage length of flights by the few aircraft types were not widely different. Even in the prejet era, before the days of "on condition" maintenance, a great deal of importance was attached to "hours," generally meaning the "off to on" time accumulated.

The advent of the jet with its transcontinental and transoceanic range and the further sophistication of design concepts brought with it the idea that the limiting factor of physical use of the aircraft would be better expressed by "cycles." This may be defined as a takeoff and the subsequent landing.

2.1 Boeing Narrow-Bodied Equipment:

Boeing designed the early 707's for 20,000 cycles which, given their estimates of the longer stage length of the aircraft translated into an "hours" figure of about 50,000. It also translated into a service life of about 17 years. At about 30,000 hours, a significant

unanticipated "rework" program was performed including "reskinning" certain wing panels. This brought the estimated service life up beyond the original 50,000 hours to 60,000 hours.

Three situations combined to make this rework desirable. First, the immediate public acceptance of the first jets led to their use on much shorter segments than the designers had anticipated and hence accelerated the time at which the cycle limit would be reached. Second, the market success coupled with the increased reliability of the jets enabled the operators to increase utilization. This also accelerated the accumulation of cycles. Finally, Boeing which had previously been accustomed to the low utilization and relatively infrequent landings of military equipment and without the years of experience with a commercial fleet such as the DC-3, DC-4 and DC-6 of Douglas, designed the 707 to operate at somewhat higher stress levels than did Douglas. One result was a lighter airplane and an attendant presumed slight fuel economy and increased payload. In the 707 series the consensus is that the amount spent in increased maintenance just about balances the economy of the lighter weight.

A number of 707's now exceed 57,000 hours and are facing another but less substantial rework at reaching 60,000 hours. Some airlines are undertaking this maintenance expense and then project the useful life to 82,000 hours. Employing normal annual utilization figures would result in a total life expectancy of 28 years. Boeing engineers indicate, and this is not disputed by the operators of 707 aircraft, that when the 82,000 hours are reached, it will be readily

possible and not too expensive in relation to replacement costs to undertake further work to extend the life to 100,000 hours or beyond. Table 15 below displays a frequency distribution of flight hours for various series of 707 aircraft.

TABLE 15

BOEING 707/720, 727, 737, 747 FLEET STATUS
IN-FLIGHT HOURS AS OF JUNE 1975

	Number of Aircraft			
Hours	707 & 720	727	737	747
60,000+				
55-60	6			
50-55	24			
45-50	56			
40-45	99			
35-40	142	7		
30-35	132	66		
25-30	159	207		
20-25	102	228	12	25
15-20	22	240	109	95
10-15	8	103	154	67
5-10	11	138	45	39
0-5	34	165	116	38

Source: Ross (1976)

Current Boeing 707 aircraft are powered by P&W JT3D engines. Earlier non-fan craft used the JT3C and JT4. Unlike the airframe, which in general terms stays intact but for repairs and modification, an aircraft engine not only is moved from plane to plane but over time undergoes almost a complete replacement of component parts. In fact it is often said that the only part of an engine which remains after a few years is the name plate displaying the serial number. The same comment is applicable to the JT8D on the 727 series, the

JT9D on the 747 and to the GE CF6. Accordingly, as with the airframe, age per se of an engine has no necessary relationship to the retirement of the aircraft. The efficiency aspect will be treated elsewhere.

The next series of Boeing aircraft considered is the 727 series. Starting the design as it did about 10 years after the design of the 707, Boeing took into consideration the experience on the 707, lowered some of the stresses on the wing and fuselage and designed the plane assuming a much shorter average length flight. Early 727 fuselages had a cold bond process which was unsatisfactory from a corrosion point of view and hot bonding replaced it. Thus the goal or design was set at 60,000 cycles. Subsequent experience indicates that the average stage length for the 727 is approximately one hour. Accordingly the design life on this basis is 60,000 hours. In 1975, the high time aircraft had over 37,000 hours, and more than 200 planes were over 25,000 hours. It will not be until 1980 that 727's will reach 54,000 hours. Since the 727 was designed on the experience of the 707, and since no structural problems have developed thus far, the conclusion is reached that it will be possible to push the service life another sizeable increment.

The Boeing 737 needs little treatment here. It was specifically designed for the higher cycles of the short haul and was also a structural advance over the preceding 707. With a chronological age of less than 9 years, a high time of about 20,000 hours and cycles of about 32,000, age in any one of these parameters is not a concern to

the operators of the 737.

In summary, for the current Boeing fleet, which number 2791 aircraft out of a total world commercial jet fleet of 4587, retirement of these planes will not come about because of their age in years, or because they have reached the end of their life because of hours in the air or cycles.

2.2 McDonnell Douglas Narrow-Bodied Equipment:

The next largest fleet is that of McDonnell Douglas whose commercial jet aircraft number 1240. As was the case with Boeing, these DC-8 series aircraft were designed for a service life equivalent to 50,000 hours (McDonnell Douglas Co. report J6903, "Structural Durability of DC-8 Jet Aircraft," June 1975). At 8 hours a day, this is a design service life of 17 years. Table 16 shows the total flight hours of certain Douglas series.

TABLE 16

DC-8-20, -30, -40, -50 Series
Fleet Status In-Flight Hours as of June 1975

Total Flight Hours (000)	Number of Aircraft
15-20	8
20-25	7
25-30	22
30-35	37
35-40	45
40-45	62
45-50	55
50-55	12
55-60	5

Source: Ross (1976)

The early Douglas planes are now about 19 years of age, are approaching 60,000 hours of use, and because of the stage lengths have fewer cycles than hours. On the basis of current structural studies Douglas is now predicting a mean service life of 82,000 hours; this translates into a 28-year service life. As aircraft in the data base mature, it is felt by the manufacturer and operators that the service life can be further extended. For example, if examination at 60,000 hours reveals that 40 cracks have developed the projected life will be 100,000 hours or 34 years. If, on the other hand, approximately 30 cracks have developed the projected mean service life will be 110,000 hours or 38 years. As previously indicated the Douglas is somewhat heavier structurally than Boeing and has had less maintenance work on it.

The Douglas DC-9 short haul plane entered service in 1965 and 1966. No structural fatigue has been found and with an age of less than ten years, with hours less than 30,000 and cycles less than 40,000 the physical life of the series projects out beyond anything of concern in this study.

In summary, for the current Douglas fleet retirement will not come about because of age in years, hours of service, or number of cycles performed.

2.3 Wide-Bodied Aircraft: Boeing 747, Douglas DC-10, Lockheed L1011:

The wide-bodied aircraft - namely, the 747, DC-10 and L1011 - were designed after taking careful account of the experience with the DC-8 and 8-8 series and much interaction between manufacturers

and the airlines. Generally speaking, particularly the airframes contain incremental refinements on existing technology and should have an even longer service life of the nature considered in this section than the narrow-bodied jets. This expectancy is confirmed by the longer depreciation periods the carriers have set up initially for the wide-bodied as compared with their previous aircraft.

E.3 DEPRECIATION, BOOK VALUE, USED AIRCRAFT PRICES IN THE JET ERA

Depreciation is often defined as "the loss, not restored by current maintenance, which is due to all the factors causing the ultimate retirement of property. These factors embrace wear and tear, decay, inadequacy, and obsolescence" (Lindheimer v. Illinois Bell Telephone Co. 29 US 151, 167 (1934)). In the air transport industry obsolescence is difficult to quantify in advance. In the prejet era we noted that despite the development of more efficient piston aircraft, obsolescence from a financial point of view was masked by a strong demand to fill an undercapacity situation. As a consequence, aircraft generally sold above book and provided some funds for the purchase of jets.

In the jet era there is a wide gap between the time one airline may start to retire a piece of equipment and that of another line. Table 17 below indicates that BAC-111's began to leave American and Braniff in 5 and 7 years respectively; Eastern's 720's began at 7 years and Continental's at 14. Such departures may mean the purchase

was early proved a mistake because of overcapacity, wrong mission, or failure to receive a contemplated route award.

TABLE 17

JET AIRCRAFT RETIRED FROM TRUNK SERVICE

Aircraft Type	Carriers	Years in Service
BAC-11	AA,BN	5,7
CV-990	AA	6
Caravelle	UA	8
DC-8-61/63	EA,NA	6,8
707-100/300	CO,BN,PA	8,9,13
DC-8-NF	PA,EA,NA,DL	8,13,13,16
DC-9-10	CO	9
CV-880	DL,TW	13,15
720	EA,AA,BN,PA,NW,UA,CO	7,9,9,9,10,12,14

Source: Ross (1976)

Table 18 below demonstrates that aircraft retired from one carrier stay in service with others much longer. For example, on Western the Boeing 720 is still flying after 15 years of service. TWA and American still have the early 707's, which were once turbojets before conversion to turbofans, pushing 18 and 19 years of age.

TABLE 18

JET AIRCRAFT REMAINING IN TRUNK SERVICE

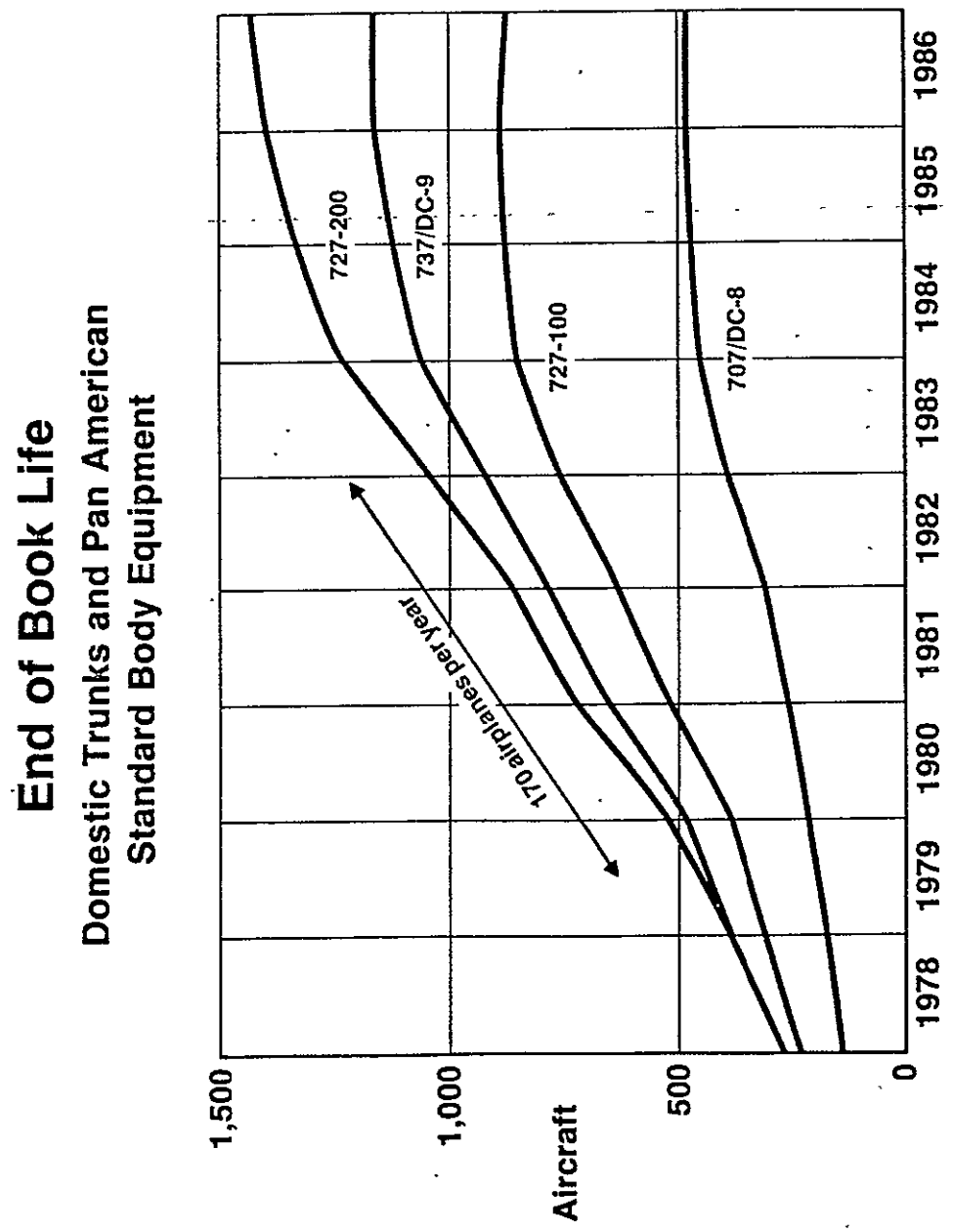
Aircraft Types	Carriers	Years in Service
707-100/300	AA,TW,PA,NW,WA	18,17,14,14,9
DC-8-NF/50	UA	17
720	WA	15
727-100	EA,UA,AA,TW,NA,NW,BN,PA	14,14,13,13,12,12,11,11
DC-9-10	EA,TW	11,11
DC-8-61/62/63	BN,DL,UA	10,10,10
DC-9-30	EA,DL	10,10
727-200	AA,CO,NA,NW,TW,UA, WA,BN,DL	9,9,9,9,9,9,8,6,5
737	UA,WA	9,9
747	PA,AA,BN,NW,TW,UA	8,7,7,7,7,7
DC-10	AA,NA,UA,CO,TW,WA	6,6,6,5,5,5
L-1011	EA,TW,DL	5,5,4

Source: Ross (1976)

If the Domestic Trunks plus Pan American were to replace aircraft as their book life expired, Boeing has calculated from public data that an average of 170 planes a year would be replaced over the period 1978-1986 as shown in Chart 4, on the following page.

The Fleet Age Distribution, Chart 5, p.115, is shown to be 8.6 years for the total fleet, 9.2 for the low-by pass fan, and 17.2 years for the non fans. Different airlines have significant differences in the rate at which their fleets are aging. Chart 6, p.116,

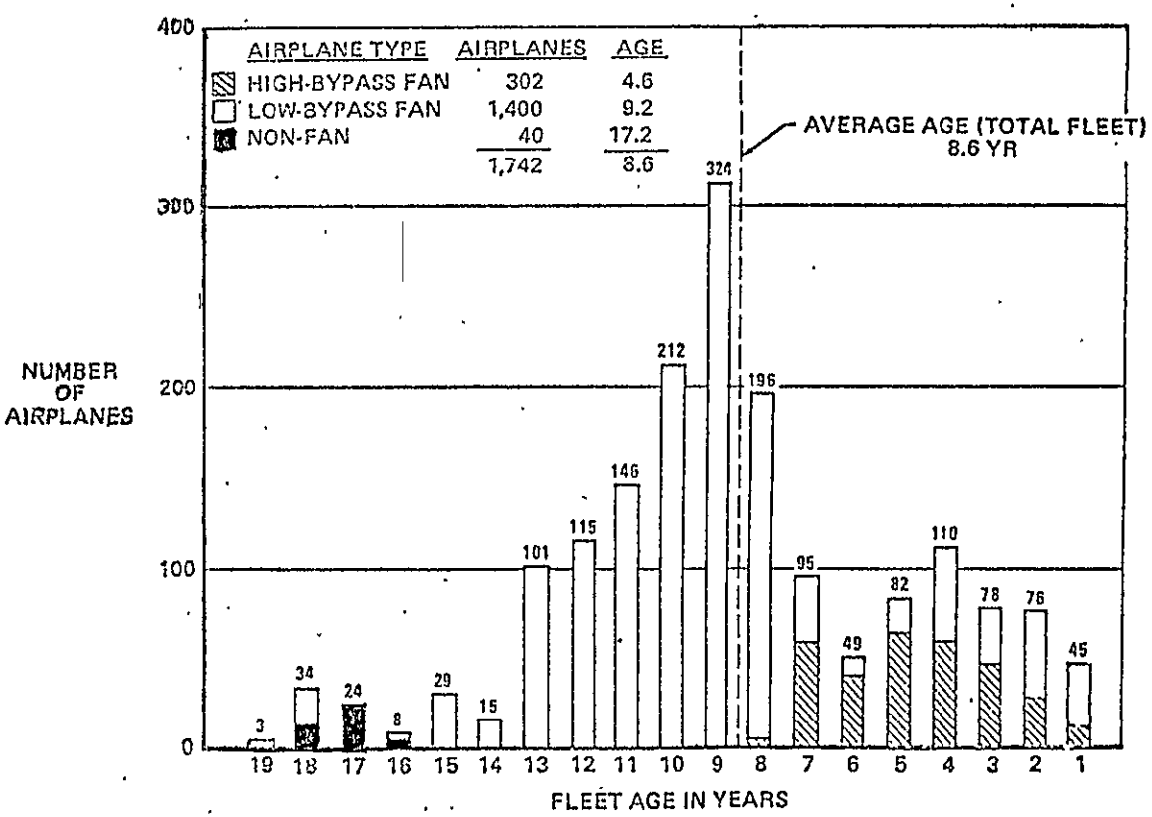
Chart 4



Source: Boeing Commercial Airplane Company, June 1976

FLEET AGE DISTRIBUTION

U.S. TRUNKS PLUS PAN AM
JET AIRPLANES IN SERVICE JANUARY 1, 1977



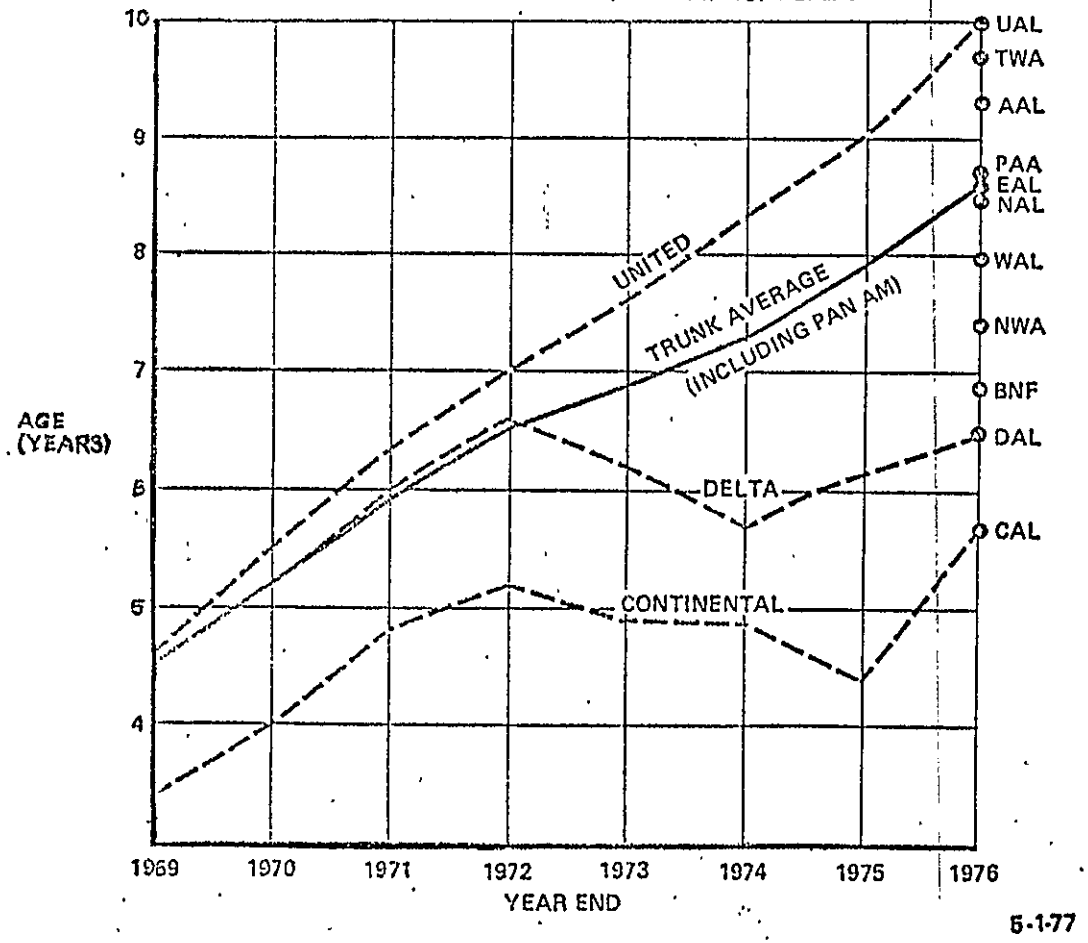
Source: Boeing Commercial Airplane Company

Chart 5

Chart 6

INCREASING AGE OF OPERATING FLEET

DOMESTIC TRUNKS AND PAN AMERICAN



Source: Boeing Commercial Airplane Company

illustrates trends. The largest airlines, the very ones that launched the jet era (PAA,AAL,UAL,TWA), have fleets that are above the trunk average age. While initially other lines followed the same aging pattern, beginning in 1972 several carriers, Continental, Delta, Northwest being very visible examples, began replacing their fleets with newer aircraft, thus lowering their average age dramatically. This action comes into focus later during the discussion on the impact of noise regulations on replacement of aircraft and on the policy problems of how to assist needy carriers with old fleets without discriminating against carriers who feel by good management they made the replacement at their own expense.

For regulatory purposes, the CAB has established depreciation periods of:

10 years - - - - - - - Turbojets

14 years - - - - - - - Turbofans

16 years - - - - - - - Wide-bodies

For business accounting, the carriers initially used the same or shorter depreciation periods. For example, Delta depreciated all aircraft over 10 years with a 10% residual while Northwest wrote off its narrow-bodies over 10 years with a 15% residual. On its wide-bodies Northwest employed 15 years with 10% residual. Subsequently when it became evident that the useful life of the narrow-bodies would exceed the book life, some airlines adjusted the depreciation periods to longer lives. The CAB itself in a recent economic study, has adjusted depreciation by adding 3 years to its normal regulatory

figures tabulated above. This investigation revealed that on an industry wide basis, airlines are depreciating their equipment for accounting purposes over a longer period than the CAB regulatory rules. However, carriers with strong finances such as Delta and Northwest did not readjust their depreciation practices. The changes in depreciation rates on the part of the carriers are a function of their desire to show earnings or minimize losses as well as to take advantage of investment credit laws. Accordingly, they are financial in character. Depreciation rates established for equipment, or the results of such rates, are not a driving factor in determining retirement policies.

The extent to which these management depreciation decisions representing actual experience during the years 1970-1975 is reflected in a study made by AVMARK Inc. Table 19 of that study relating to the U.S. certificated air carriers indicates that 841 planes were sold for $1.5 billion which figure was $232 million more than book value. In the case of Northwest, its book profit was 47%. The profit may not mean that Northwest was a shrewder bargainer but that it had a higher rate of depreciation on its fleet.

To the extent that used aircraft prices impinge on the decisions to retire aircraft, a market must exist or the decision must be made on the basis of scrap value. And to the extent that the past gives some basis for assessing the future, a review of where retired aircraft have been going is desirable. A study by AVMARK, Table 20, indicates that in the 1970-75 period 70 jets have "trickled down" to the

Table 19

SUMMARY OF USED AIRCRAFT SALES BY U.S. CERTIFICATED AIR CARRIERS - 1970-1975

Airline	Number Sold	Gross Sales Price	Book Profit (loss)	Percent Profit
American	66	$ 213,245,000	$ 21,663,000	10.2%
Braniff	36	79,942,000	3,916,000	4.7
Continental	39	142,693,000	(722,000)	(0.5)
Delta	68	106,574,000	22,578,000	21.2
Eastern	87	262,943,000	16,197,000	6.2
National	12	19,171,000	3,048,000	15.9
Northwest	51	166,264,000	78,638,000	47.3
Pan American	57	102,442,000	18,021,000	17.6
TWA	25	62,930,000	(5,015,000)	(8.0)
United	57	53,866,000	10,158,000	18.9
Western	27	32,112,000	9,786,000	30.5
Total Trunks	525	$1,242,181,000	$178,313,000	14.4%
Allegheny	43	$ 21,186,000	$ 1,913,000	9.4%
Frontier	18	24,134,000	1,769,000	7.3
Hughes Airwest	26	11,933,000	4,096,000	34.3
North Central	3	1,822,000	(8,000)	(0.4)
Ozark	3	5,654,000	1,977,000	35.0
Piedmont	6	1,597,000	135,000	8.5
Southern	14	10,062,000	1,973,000	19.7
Texas International	3	5,293,000	(67,000)	(1.3)
Total Regional	115	$ 57,547,000	$ 11,788,000	20.6%
Alaska	20	$ 6,022,000	$ 104,000	1.7%
Aloha	2	140,000	13,000	9.3
Hawaiian	2	7,586,000	1,800,000	23.7
Kodiak	10	446,000	188,000	42.2
Reeve	3	141,000	119,000	84.4
Wien	2	150,000	52,000	34.7
Total Territorial	39	$ 14,485,000	$ 2,276,000	15.7%
Airlift	22	$ 24,771,000	(3,053,000)	(12.3%)
Flying Tigers	13	43,591,000	6,196,000	19.0
Seaboard World	6	36,237,000	6,596,000	18.1
Total All-Cargo	41	$ 104,599,000	$ 9,739,000	10.4%
Capitol	23	$ 19,420,000	$ 6,862,000	35.3%
Johnson (Evergreen)	30	778,000	365,000	46.9
McCulloch	10	3,410,000	726,000	21.3
Modern	8	3,248,000	(3,038,000)	(93.5)
Overseas National	12	28,162,000	5,954,000	21.1
Saturn	20	11,700,000	526,000	4.5
Trans International	5	22,287,000	2,430,000	10.9
World	12	57,947,000	16,007,000	27.6
Total Supplementals	120	$ 146,952,000	$ 29,832,000	20.3%
TOTAL INDUSTRY	841	$1,565,767,000	$231,948,000	14.9%

Source: AVMARK, Inc., Miami, Florida

TABLE 20

USED AIRCRAFT - WHERE THEY WENT

U.S. Carrier Industry

1970 - 1975

Purchased By	Number Aircraft	Total Transaction Value (000)	Average Transaction (000)	Percent Total Value	Percent Total Number
Far East, Asia & African Area	57	$221,566	$3,887	13.1%	6.6%
Middle East Region	37	179,838	4,860	10.6	4.2
U.S. Local Service Airlines	70	173,337	2,476	10.2	8.2
Canada and Caribbean	57	144,100	2,528	8.5	6.6
Latin America	59	137,542	2,331	8.1	6.8
U.S. Manufacturers	54	136,299	2,524	8.0	6.2
European Cargo & Charter Airlines	73	131,723	1,804	7.8	8.4
U.S. Trunk Airlines	18	129,785	2,210	7.6	2.1
European Scheduled Airlines	28	97,702	3,489	5.8	3.2
Brokers in USA	117	69,861	597	4.1	13.5
U.S. Supplemental Air Carriers	52	66,115	1,271	3.9	6.0
U.S. All-Cargo Carriers	3	40,045	13,348	2.4	.3
Financial Institutions and Leasing Companies	43	45,770	1,064	2.6	4.8
European Brokers	25	30,887	1,235	1.8	2.9
U.S. Territorial Airlines	21	28,194	1,128	1.7	2.4
Aircraft Sold and Repossessed	15	17,801	1,187	1.1	1.7
Sales to Third Level Carriers, Flying Clubs, Corporations, Individuals and Others	137	43,790	320	2.6	15.9
Total Transactions	865	$1,694,345	$1,959	100.0%	100.0%

The foregoing data is from air carrier reports to the U.S. Civil Aeronautics Board and shows the purchasers listed by the airlines. In certain cases, especially those involving brokers and financial institutions, the aircraft were subsequently transferred to third parties. Further, data does not necessarily accurately reflect the extent of actual owners of the aircraft.

Source: AVMARK, Inc., Miami, Florida

U.S. Local Service Airlines involving a sum of $175,000,000. However, more significantly, 37 planes went to the Middle East Region for about $180,000,000. Finally, 57 aircraft were sold to the Far East, Asia and African Area for $223,000,000. AVMARK projects an increase in the price of used aircraft even in the face of a substantial potential increase in offerings of U.S. Carriers desired or being forced to retire their noisy high cost fleets. We, however, do not think the market can absorb quantity and maintain higher prices.

E.4 CONCLUSION ON AGING OF THE CURRENT JET FLEET

4.1 Narrow-Bodied

The current jet era began in 1958 with the advent of the coast-to-coast Boeing turbojet. Following quickly were Douglas DC-8 and Convair 880 turbojets. The normal power plant was the P&W JT-3 and JT-4. In 1961, a quieter more efficient engine, the JT-3D, was developed and powered all production aircraft. Some airlines reequipped their existing aircraft with the new turbofans. In 1964 and 1965, the shorter range, smaller 727 and DC-9 were introduced powered by a new P&W JT8D turbofan. Unless sold to other carriers, these aircraft and their power plants have been in use by the purchasing carriers continuously. Some of the older 707 and DC-8 series are reaching 19 years of age, far beyond the original depreciation periods set by the original purchasers, and approaching the design life span of the aircraft using hours as a standard.

Careful engineering analysis and structural retesting by the manufacturers and users have developed the fact that with some additional maintenance, the life span can further safely be extended by additional significant increments up to 82,000 and then 100,000 hours. This would bring the life span up to 30 or 40 years. With respect to depreciation, it is largely a management decision which is not necessarily based on the expected useful life of the aircraft. Therefore, neither chronological age per se or book life can be said to be a factor causing the retirement or even affecting the retirement of current jet aircraft.

4.2 Wide-Bodied

The wide-bodied jumbo 747 aircraft was introduced in 1970 followed by the DC-10 and L1011 in 1972. The manufacturers aver, and in general the purchasers agree, that additional quality has been built into these airframes taking advantage of the lessons learned from their previous models. Thus, age will be of no concern for a very long time. These aircraft are powered with a new generation of high bypass engines. The users are not ready to agree on their life span.

F.

REPLACEMENT DECISIONS: A FINANCIAL PERSPECTIVE

We examine financial aspects of the aircraft retirement decision in this section. Since industry demand is generally perceived as rising, the retirement decision is in fact a decision to replace. We begin our discussion by introducing the economic logic of replacement decisions. Perhaps, the single key element in that decision process is defining the discount rate which will equate the sum of future cash flow benefits with the current cost of obtaining new planes. The discount rate is taken to be the marginal cost of additional capital funds. As this marginal cost is determined by investors, based on their perception of return-risk characteristics of the firm, we focus our attention next on the economic performance of airlines in the 1966-75 period.

There are several qualifications to be made before we begin. First, our approach to airline industry financial problems is a descriptive one. That is, while we focus almost exclusively on quantitative aspects of performance, our emphasis is on the "proximate" determinants of the record. We do not examine industry financing in terms of explicit behavioral models simply because of a lack of funding, rather than a disdain for such work. Second, our financial analysis focuses on the "Big Eleven" trunk carriers: American, Braniff, Continental, Delta, Eastern, National, Northwest, Pan Am, Trans World, United and Western. These firms own the bulk of the

domestic jet fleet, and operate nearly all of the aging, noisy, and fuel-inefficient craft.

It is important that we distinguish the sources data used in this section. With few exceptions, these data are derived from the COMPUSTAT tapes supplied monthly to the financial community by Standard and Poor.[25/] As such, the data shown in our calculations are based exclusively on the annual audited statements of air carriers. Use of the COMPUSTAT series requires some additional clarification. We note that all balance sheet information employed here are measured in "book" rather than "market" terms. The data employed for all carriers are those of the consolidated form, reflecting the performance and structure of airline as well as other subsidiaries. (Our choice here is a deliberate one since it is the consolidated reports which are of concern to the financial institutions.) Finally, we note that our data are based on fiscal years. For all but two carriers, the 1975 fiscal year coincides with the calendar year.[26/]

F.1 THE CALCULUS OF REPLACEMENT DECISIONS

The ultimate purchase decision for new aircraft is a financial one. True, the technological characteristics of the new craft and

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25/ C.E. Ferguson, Jr. and W.G. Glimpse (1976). COMPUSTAT Analysis System: Users' Guide, Investors Management Sciences, Inc.

26/ Exceptions and final month of fiscal year are: Delta (June) and National (June).

the craft to be replaced are integral to this decision. However, the outcome of this process will depend on several other variables which are unrelated to the new aircraft (e.g., the firm's capital structure and level of interest rates prevailing in the economy). Our task in this section is to summarize the decision rules involved in the equipment replacement decision and to describe the requisite calculations for these rules.

The distinguishing characteristic of capital equipment is that it provides services over a lengthy period. Managers must thus concern themselves with a multiperiod profitability calculation. For each future period up to its retirement date the equipment is presumed to generate cash flows ("profits" plus depreciation) which can be well estimated as of the current date. Replacement decisions require that we examine two distinct series of future cash flows: (i) those specific to the existing equipment, and (ii) those implicit in use of new equipment. That is, replacement implies that new equipment will displace current equipment in some given service activity. The differential cash flows resulting from replacement must be sufficient to justify purchase.

The cash flows resulting from continuing use of existing equipment are not difficult to project, since the service in which these craft are used is well understood, as are the craft's operating characteristics. Indeed, the only real difficulty here is in anticipating inflation in the unit prices of associated inputs (e.g., fuel and wage rates). The future cash flows specific to new equipment are

often more difficult to project accurately. This is typically the case where a new type of aircraft is under consideration, since its operating characteristics are often not established and the plan may well provide a different type of service (thereby altering demand).

Should an airline consider replacement of existing craft with new ones, the extended cash benefits will be of four types:

i) revenue gains through improved availability or altered service characteristics;

ii) operating cost reductions produced by lower weight, reduced fuel consumption, etc.;

iii) increased cash flows as the result of larger depreciation allowances; and

iv) decreased tax levels associated with the higher levels of depreciation or with any legislated special tax treatment.

In the context of the current debate some important qualitative views of these benefits can be made. We note first that the revenue gains from new aircraft will be slight indeed since new craft will not per se generate increased numbers of passengers. True, where higher capacity planes are substituted for DC-9's and 727-100's there will be passenger gains in certain limited capacity markets. However such markets are few in number - and additions to this market classification are not developing rapidly. Our analysis indicates that compared with current wide-bodies only limited operating cost reductions would be associated with a new-design aircraft. Reductions in operating costs will be largely in the form of fuel savings -

these the result of improved engine efficiency and lowered gross takeoff weights. The weight reductions now in view appear largely due to limited use of composite materials.

The "tax benefits" of new aircraft are immediate and are supportive of replacement. That is, the financial community focuses on the cash flow - net income plus depreciation - implications of an investment decision. The value of depreciation allowances, however, is conditional on positive values of taxable income. To the extent that pretax earnings are minimal, the tax savings associated with increased depreciation are slight. The latter situation, of course, has been typical of U.S. trunk carriers in the 1970's.

Replacement implies that the older aircraft in fact leaves the fleet, thus generating immediate cash benefits. In a world of stable prices the sale price of the old plane will closely approximate its book value. As such the sale of older aircraft will not affect the firm's tax liabilities. However, the extreme inflation rates of the past decade have produced an understatement in aircraft book values. Thus aircraft which are current replacement candidates have market values well in excess of book - and their sale will produce taxable income. Consider the following: the Boeing B-737-200 which was purchased for $4.4 million in 1970 has a current market value of $3.5 million. Employing a ten-year service life, sum-of-the-year's-digits depreciation scheme, and a $1 million salvage value the 1977 book value of this plane is but $1.6 million. Thus

the sale of a six-year-old aircraft could produce a tax liability as high as $912,000.[27/]

The replacement decision involves comparing the purchase price of the new aircraft (less the proceeds from sale of the old craft, net of tax liabilities incurred in that transaction) with the stream of future benefits obtained from operating the new plane in place of the older one. Since these future cash flows are obtained over time, they must be discounted to allow for earnings foregone by the firm as a result of the new aircraft purchase. The appropriate interest rate for such discounting would be the rate attached to a risk-free asset (e.g., short-term treasury bills) if the future returns were a certainty.

Considerable uncertainty is associated with the cash flows produced by a fleet of new aircraft. This stems from lack of information on technical performance, changing regulatory attitudes, competitive forces, etc. Accordingly, the case can be made for using a discount rate (in excess of the "risk-free rate") which reflects the risk characteristics of the new craft. By most conventional measures of trunkline risk, this sector is one of the more risky in the U.S. economy. It follows that the discount rates used to analyze new aircraft purchases will be high relative to those used by other firms in capital budgeting.

27/ These data are taken from Avmark, Inc., Transport Aircraft Values, 1970-1984. Miami, 1976.

The final step in the replacement calculus is to ask if the discounted future benefits from purchase exceed the net cost of the new equipment. If this result obtains, the aircraft will be purchased because this investment will increase stockholders' earnings and thus raise the market value of the firm's equity shares. Should the net purchase price exceed the discounted value of the future cash flows associated with purchase, then the aircraft would not be purchased. And this because the returns from the investment would fail to match the stockholders' earnings expectations, thereby producing a decline in the value if the stock.

The key features, then, in the replacement decision are the following:

i) uncertainty associated with cash flows from new aircraft;

ii) tax implications coincident with retirement of older planes and depreciation of new ones; and

iii) derivation of discount rates applicable to the future cash flows which adequately reflect the risk structure of the firm and industry.

The following paragraphs of this section review the current performance of the trunkline industry. This performance gives key indications as to the nature of uncertainty, tax considerations, and risk structure. From these findings, we go on to examine qualitatively the prospects for fleet replacement under alternative economic and regulatory scenarios.

F.2 LEVERAGE AND RISK STRUCTURE

The cost of obtaining funds - as well as the potential barrier to any funding - is tied to the capital structure of a firm. That is the relative size of debt and lease obligations in all corporate capital funds (leverage) influences the rate which must be paid to produce new capital funds. This is especially the case when "fixed obligations" (debt service and lease payments) bulk large relative to cash flow.

Table 21 examines the leverage position of the trunk carriers in the period 1971-75. Part A of this table shows the ratio of long-term debt to all long-term (or "permanent capital") funds; this is the proportion of long-term funds obtained from creditors. While the tax deductibility of interest payments makes debt an attractive form of fund raising to the shareholders, when debt becomes too high the possibility of default - which places at risk the assets held by shareholders - discourages high debt proportions. In this context the data of Panel A are interesting. While no trend emerges for the carriers, it seems clear that long-term debt has remained a fairly stable proportion of all capital.

In recent years firms have engaged in a good deal of "off the balance sheet" financing - i.e., leasing of capital equipment. That this has been particularly true of trunk air carriers is seen in Part B of Table 21. Here we adjust the long-term debt-to-permanent-capital ratio by adding lease obligations to both numerator and denominator. The resultant ratio more fairly reflects the firm's

Table 21

SELECTED FINANCIAL RATIOS: 1971-1975

U.S. Domestic Trunks Plus Pan Am

Item	Firm	1971	1972	1973	1974	1975
A. Long Term Debt/Long Term Debt plus Equity	AAL	.572	.573	.579	.531	.528
	BNF	.682	.658	.655	.618	.508
	CAL	.744	.696	.709	.717	.746
	DAL	.550	.517	.493	.564	.580
	EAL	.654	.620	.716	.686	.701
	NAL	.594	.667	.658	.579	.580
	NWA	.446	.410	.438	.387	.397
	PAA	.708	.717	.708	.739	.760
	TWA	.732	.724	.730	.739	.760
	UAL	.672	.674	.653	.630	.644
	WAL	.680	.626	.590	.554	.550
B. Long Term Debt plus Lease Payments/L.T. Debt plus Equity plus Lease Payments	AAL	.768	.778	.796	.788	.800
	BNF	.855	.842	.832	.829	.825
	CAL	.804	.769	.788	.784	.810
	DAL	.619	.593	.599	.629	.640
	EAL	.859	.817	.863	.866	.879
	NAL	.700	.730	.732	.690	.696
	NWA	.497	.463	.499	.462	.470
	PAA	.802	.811	.812	.844	.863
	TWA	.870	.861	.876	.875	.904
	UAL	.806	.814	.786	.769	.780
	WAL	.795	.773	.765	.760	.777
C. Times Interest Earned*	AAL	4.0	4.6	2.8	6.2	4.3
	BNF	4.2	5.0	4.6	4.1	4.2
	CAL	3.9	4.2	2.9	2.4	1.9
	DAL	8.4	12.7	13.9	10.2	6.4
	EAL	3.2	4.2	1.6	2.6	1.9
	NAL	2.6	6.0	5.7	6.3	4.4
	NWA	7.8	12.8	10.7	9.9	9.2
	PAA	1.9	2.4	2.5	.8	2.3
	TWA	3.8	6.5	6.2	2.6	1.4
	UAL	3.8	4.7	5.9	7.8	4.0
	WAL	4.9	6.3	8.0	8.2	5.5

* Includes book depreciation.

TABLE 21 (continued)

Item	Firm	1971	1972	1973	1974	1975
D. Coverage**	AAL	1.6	1.6	1.0	1.9	1.1
	BNF	1.9	2.1	2.2	2.1	1.9
	CAL	2.7	2.7	2.0	1.9	1.4
	DAL	4.6	5.0	4.5	4.2	3.0
	EAL	1.4	1.8	.8	1.4	1.0
	NAL	1.6	3.7	3.5	3.8	2.5
	NWA	3.2	3.9	4.3	4.7	3.8
	PAA	1.2	1.5	1.6	.5	1.4
	TWA	1.7	2.3	2.2	1.3	.7
	UAL	1.8	2.2	3.0	3.7	1.9
	WAL	2.9	3.4	4.0	3.9	2.1
E. Return on Equity	AAL	.005	.010	-.089	.36	-.038
	BNF	.106	.158	.176	.169	.122
	CAL	.070	.064	.001	.052	-.066
	DAL	.106	.133	.181	.204	.102
	EAL	.017	.061	-.167	.022	-.190
	NAL	-.032	.140	.126	.163	.058
	NWA	.045	.036	.097	.110	.070
	PAA	-.103	-.070	-.047	-.267	-.180
	TWA	.004	.128	.120	-.070	-.315
	UAL	-.013	.034	.079	.130	-.008
	WAL	.068	.116	.179	.182	.037
F. Return on Assets	AAL	.025	.023	-.015	.034	-.002
	BNF	.074	.089	.102	.123	.087
	CAL	.058	.060	.037	.074	.026
	DAL	.078	.104	.145	.159	.083
	EAL	.044	.052	-.009	.056	.003
	NAL	.002	.086	.090	.133	.054
	NWA	.026	.027	.065	.107	.053
	PAA	-.001	.003	.014	-.050	-.001
	TWA	.029	.051	.055	.020	-.020
	UAL	.024	.040	.068	.109	.021
	WAL	.058	.081	.121	.134	.032

** Includes book depreciation. Coverage is ratio of earnings before interest and taxes to interest plus one-third of rentals.

fixed obligations and the relative position of the stockholder. A different picture of leverage now emerges. To wit, trunk carriers are extremely leveraged. And in the case of six carriers this leverage has increased with time. These ratios are very high relative to other firms in the U.S. economy.

Parts C and D of Table 21 focus on the ability of trunk carriers to meet fixed obligations. These are the so-called coverage ratios. The first of these stresses interest coverage, the second provides for coverages of both interest and capital rentals (leases). In both cases the diversity of averages is of interest. The financial strength of both Delta and Northwest is the most striking finding: the tenuous - and deteriorating - situation for American, Continental, Eastern, Pan Am and TWA, the most perplexing.

Extreme leverage and poor coverage performance require explanation. One must ask how, in the face of poor coverage, the trunk carriers have developed such a high debt structure. The answer to this question lies in the economic history of the industry. The period bounded by 1946 and 1955 was one of strong traffic growth. Financing of early postwar equipment was made possible by retained wartime earnings and current internal funds (cash flow). With the advent of commercial jet aircraft, capital needs grew very rapidly. During the 1956-61 period, some 40% of all funds were obtained through the sale of long-term debt. The specific debt instrument employed most often was the debenture; life insurance companies were the purchasers.

The first 4-engine jet aircraft provided a substantial shift on both the nature and quantity of air passenger service. During the 1961-66 period, capital spending continued at a high level as twin- and tri-jets were substituted for prop and turbo-prop equipment. Carriers turned to the substantial cash flows (especially profits) generated by these jet craft and their predecessors to finance this accumulation. Dividend payouts remained low (consistent with the pattern of growth industries), declining slightly as a relative use of funds. The developments of the early sixties, then, caused little concern on the part of the senior lenders as carrier leverage declined and profitability appeared growing.

The 1966-71 period gave rise to substantial spending on flight and ground equipment. This, of course, involved the refinement of twin- and tri-jet configurations and the introduction of wide-body aircraft. During the period, funds came from a multiplicity of sources: convertible debt issues, bank borrowing, and (late in the period) leasing. Unfortunately, the heavy commitments of this period coincided with a rapid deterioration in the profitability of the carriers.[28/] This declining profitability made the financial commitments of the late sixties look unattractive almost immediately. While the insurance companies' unsecured position worsened, these lenders took hope in the promise of improved financial performance.

28/ While this decline is partly the result of excess capacity associated with the high level of purchases, it is not our task here to explain the determinants of profitability. Rather we seek only to describe the implications of shifting profitability for industry financing.

This improvement was ascribed to two factors: a seemingly sympathetic regulatory agency and projected demand growth which would alleviate excess capacity. Neither of these materialized.

1971-75 witnessed both demand instability and a call for regulatory reform. Slow and fluctuating demand for air passenger service - coupled with severe input cost escalation - produced a worsening economic record for nearly all carriers. In several cases, the results were nearly disastrous (Eastern, Pan, and TWA). High interest rates brought those carriers which had relied on bank financing into continuing difficulties with these lenders, and worsened relations with long term lenders. Indeed the declining fortunes of the carriers served to cut off insurance sources since these lenders portfolio decisions are narrowly circumscribed by regulators who focus largely on coverage performance. That the rising call for "regulatory reform" (especially easing of entry restrictions) caused concern among these lenders, as well as aircraft lessors, is hardly surprising. While the demand for funds was limited during the period, the supply was more constrained. True, financing was arranged; but at rates which were increasingly tied to forces in capital markets and at maturities which were ever shorter. Not surprisingly, depreciation and increases in short-term liabilities provided about two-thirds of all funds, 1971-75.

In sum, the 1966-75 decade was one of changing fortunes for the trunk carriers industry. Substantial commitments of capital funds failed to yield the projected cash flows. And this failure produced

an ever-increasing tension between borrower and lender. The 1976-7 aircraft financing has been limited. Where equity has been used it has been very expensive. This statement, however, does not characterize all carriers and one must examine the record of each carrier more carefully to determine future financing possibilities in the industry.

F.3 INVESTMENT PROFITABILITY AND SOURCES OF EARNINGS

Relatively high debt levels are a desirable result under certain circumstances. As noted earlier, the tax deductibility of interest payments means that debt funds can be obtained at a lower, after-tax rate than equity funds. To the extent that earnings are stable, the returns on the assets financed by debt will increase stockholder wealth. However, unstable (uncertain) earnings' streams are not consistent with high relative levels of debt funding, since this instability increases default probabilities. Even instability of earnings may be tolerated should average returns on invested funds be sufficiently above zero.

The data in Parts E and F of Table 21 allow us to review the level and variation in trunk carrier profitability. Return on equity is simply the ratio of after-tax profits to equity. The generally low level of profitability observed is most striking. Indeed, any industry mean will be distorted by the performance of two carriers: Braniff and Delta. It is axiomatic that highly-levered firms will experience greater after-tax earnings variability than less-levered firms, and this is seen in Part F. Of definite concern here is the

return on assets record. Return on assets is here defined as the ratio of taxable income plus interest obligations to total assets. With the exception of the two carriers mentioned earlier, the record is not a good one: (i) several carriers recorded persistent growth during the seventies (NAL, NWA, UAL, WAL) only to have the trend destroyed by the recession of 1975; (ii) the remaining carriers exhibit trendless and chronically low returns throughout the period.

Return on assets is, however, but one ingredient in the return to equity holders calculation. And it is the equity return which required our attention. Specifically, given the highly levered capital structure in the industry, the major future external source can only be equity (i.e., income retention or sale of stock). The extent to which equity financing can be obtained depends on the return-risk characteristics of any new issue. To determine the prospective return, we turn to a detailed analysis of the sources of after-tax profits in the trunkline sector.

The level and growth of after-tax profits is the result of two forces: economy-wide developments in prices and income, and managerial decisions on supply, financing and tax policy. One approach to separating these influences follows. Define the following variables:

Y: after tax profits

L: total liabilities

E: equity

X: before tax profits

I: interest payments

T: all tax payments

We also define several ratios of interest,

π: return on assets

ι:= average interest cost

θ: effective tax rate

That is,

$$\pi = (X + I)(E + L)^{-1}$$

$$\iota = IL^{-1}$$

$$\theta = TX^{-1}$$

Using these definitions one may derive an expression for the proximate determinants of profits:

$$Y = (1-\theta)\{\pi-\iota)L\}$$

With a stable capital structure (constant E and L) shifts in profitability may come from changes in: (i) operating profitability, (ii) interest charges, and (iii) tax policy. Rising fuel prices, for example, would lower π *ceterus paribus*. Similarly a decline in short-term interest rates will lower average interest costs; and a switch in depreciation policy to accelerated methods will raise depreciation charges and lower tax liabilities.

This view of equity returns gives rise to Table 22 which examines the ten-year history of earnings sources in the trunkline industry. Data are shown for eleven carriers. The following series are presented: return on assets as defined above, "financial gain" (the difference between return on assets and average interest cost), and the effective tax rate. The last of these would have a maximum

TABLE 22

COMPONENTS OF EQUITY EARNINGS 1966-1975

Firm	Year	Return on Assets	Financial Gain	Effective Tax Rate	Earnings Per Share
AAL	1966	.097	.067	.378	2.90
	67	.072	38	.295	2.38
	68	.055	18	.211	1.75
	69	.056	19	.210	1.90
	70	-.002	-.035	.282	-1.30
	71	.025	-.016	.083	.11
	72	.023	-.011	.121	.20
	73	-.015	-.051	.213	-1.69
	74	.045	.003	.250	.72
	75	-.002	-.028	.221	-.72
BNF	1966	.084	.057	.147	.95
	67	.046	.002	.000	.25
	68	.072	.023	.223	.55
	69	.058	.007	.206	.32
	70	.026	-.023	.311	-.13
	71	.073	.024	.280	.49
	72	.089	.045	.247	.86
	73	.102	.050	.263	1.16
	74	.123	.050	.311	1.31
	75	.087	.030	.243	1.02
CAL	1966	.201	.169	.474	1.59
	67	.120	.089	.401	1.57
	68	.040	.004	.190	.37
	69	.039	-.002	.244	.25
	70	.040	.000	.285	.29
	71	.057	.010	.392	.59
	72	.060	.014	.470	.64
	73	.037	-.019	1.086	.01
	74	.074	-.008	.277	.57
	75	.026	-.040	.430	-.68
DAL	1966	.218	.191	.466	1.81
	67	.260	.222	.459	2.57
	68	.155	.117	.449	1.89
	69	.136	.092	.466	2.05
	70	.142	.072	.431	2.33
	71	.078	.025	.289	1.57
	72	.104	.060	.383	2.20
	73	.145	.101	.432	3.32
	74	.159	.104	.438	4.56
	75	.083	.021	.340	2.40

TABLE 22 (continued)

Firm	Year	Return on Assets	Financial Gain	Effective Tax Rate	Earnings Per Share
EAL	1966	.047	.018	.000	1.47
	67	.057	.030	.240	2.12
	68	.017	-.027	.248	1.02
	69	.033	-.013	.282	-.19
	70	.044	-.003	.256	.46
	71	.044	-.009	.239	.33
	72	.052	.011	.242	1.21
	73	-.009	-.056	.199	-2.69
	74	.056	-.008	.240	.41
	76	.003	-.051	.000	-2.61
NAL	1966	.231	.199	.464	2.62
	67	.163	.129	.458	2.03
	68	.139	.111	.469	2.51
	69	.132	.081	.464	2.25
	70	.037	-.004	.192	.61
	71	.002	-.051	.650	-.46
	72	.086	.041	.331	2.32
	73	.090	.039	.396	2.36
	74	.133	.062	.429	3.58
	75	.054	-.011	.126	1.33
NWA	1966	.243	.221	.465	2.90
	67	.237	.210	.468	3.21
	68	.157	.140	.472	2.74
	69	.112	.101	.364	2.46
	70	.055	.036	.003	2.10
	71	.026	-.013	-.810	1.01
	72	.028	-.001	-.025	.82
	73	.065	.030	.069	2.40
	74	.107	.048	.342	3.00
	75	.053	.012	.078	2.01
TWA	1966	.086	.043	.389	3.29
	67	.064	.031	.120	4.12
	68	.035	.001	-.396	2.15
	69	.035	.001	-.174	1.95
	70	-.039	-.073	.295	-6.09
	71	.029	-.010	-1.268	.27
	72	.051	.026	.187	3.50
	73	.055	.029	.329	3.71
	74	.020	-.022	-.033	-1.82
	75	-.019	-.062	.166	-6.35

TABLE 22 (continued)

Firm	Year	Return on Assets	Financial Gain	Effective Tax Rate	Earnings Per Share
UAL	1966	.068	.040	.386	2.31
	67	.089	.059	.324	3.96
	68	.063	.030	.460	2.27
	69	.067	.025	.453	2.43
	70	.003	-.037	.187	-2.22
	71	.024	-.019	.144	-.24
	72	.040	-.001	.406	.97
	73	.068	.025	.500	2.41
	74	.109	.066	.549	4.17
	75	.021	-.020	-.023	-.72
WAL	1966	.191	.151	.467	1.22
	67	.110	.082	.453	.82
	68	.056	.027	.359	.56
	69	-.034	-.092	.553	-.81
	70	.036	-.023	1.360	.04
	71	.058	.008	.306	.39
	72	.081	.033	.360	.74
	73	.121	.075	.422	1.35
	74	.132	.081	.424	1.59
	75	.032	-.009	-.190	.34

value of .48 were there no "other taxes" included in T, no income averaging procedures available to corporations, no tax on capital gains, or special treatment of foreign income. (That these conditions do not always obtain accounts for effective tax rates outside the interval 0 to .48.)

Perhaps the best way to examine Table 22 is on an average basis. The trends developed for the industry can then be compared with individual carriers at the reader's convenience. Return on assets statistics were earlier examined only for the 1970's. Within the context of the past decade further remarks are in order. Specifically, dramatic declines in asset profitability characterize the 1966-75 period, with the exception of BNF and UAL. Of greater concern is the fact that return rates for the industry have fallen dramatically relative to economy wide returns. While the sources of this decline in profitability are manifold, two factors seem critical; (i) rapid escalation of input unit prices - first labor, then fuel; and (ii) inadequate productivity gains associated with aging, or oversized, craft and fleets.

Financial gain ($\pi - \iota$) measures the extent to which asset profitability exceeds the average cost of borrowing to provide these assets. In a sense this statistic describes corporate gains from leverage. We noted earlier the extremely high leverage in the industry, as well as the potential value of debt instruments; and turn now to *ex post* performance. The reported values of this statistic are extremely disappointing. The rapid inflation rates

of the past decade caused problems through the business sector: interest rates rose rapidly to reflect inflationary expectations, while asset returns failed to keep pace. In other sectors, however, this development simply narrowed the amounts of financial gain. In the air trunkline group, the same trend caused numerous carriers' financial gain to become negative, i.e., on average these firms were actually obtaining less from all assets than the cost of borrowed funds. A painful result under any circumstances, the impact of after-tax earnings in such a highly leveraged industry was devastating. (This remark is simply a restatement of the "double whammy" implicit in leverage.)

A few carrier-specific remarks on financial gain are in order: Note first that, with the exception of DAL, all of the trunks are experienced in negative financial gain. In several cases these problems were associated with the rapid growth of interest on short-term business loans during the 1969-70 period and were not persistent. However, several carriers have faced regularly negative values for financial gain, and in some cases the situation has worsened. Finally we note that the inflation of 1975, and the resultant increase in short-term borrowing rates, produced negative financial gain figures for all but three (BNF, DAL, NWA) carriers. Worst hit by the events of 1975 were those carriers which have substantial bank revolving credit agreements (CAL, EAL, PN, TWA) since these loans carry interest rates which float with money market rates. It should be added that the problems of 1975 were made the more severe by credit

agreements which required higher effective rates above prime and further restricted financial management practice.

Tax policy can, of course, exert a strong and potentially counter-cyclical influence on corporate earnings. While there are numerous ways of lowering the effective tax rate, thus raising after-tax profits, the leading technique in the airline industry has been accelerated depreciation. Acceleration is only a temporary avoidance, but in a world of positive interest rates it is a desirable strategy. And in certain firms asset growth may proceed at sufficiently high rates to produce indefinite postponement. (While this situation is unusual, it is not far from the case which existed when wide-bodied aircraft started to join the trunk carrier fleet.)

Effective tax rates for the trunks are given in Table 22. With the exception of Delta these rates are not typical of the economy. This is due to: (i) the high levels (and age) of capital investment in airlines relative to other sectors, and (ii) the propensity of airline management to select accelerated depreciation schemes. The following Table 23 - derived from the Compustat data base - illustrates this point.

TABLE 23

COMPARISON OF EFFECTIVE TAX RATES

Industry or Firm	Effective Tax Rate 1966	1975
Communication	.48	.45
Utilities	.38	.32
Transportation	.38	.35
AAL	.38	.22
BNF	.15	.24
CAL	.47	.43
DAL	.47	.34
EAL	.00	.00
NAL	.46	.13
NWA	.47	.08
PAA	.39	.15
TWA	.39	.17
UAL	.39	-.02
WAL	.47	-.19

Clearly the airline industry has employed investment tax credits and tax deferral schemes to an extent not at all common to other regulated, capital intensive sectors. We emphasize this point because the value of such deferrals is conditional on the level of taxable income. To the extent that the low return record of the past several years continues through the remainder of the decade, one must conclude that tax policy will not continue to provide substantial capital fund sources.

Equity return data are of interest because they condition the level of capital sources: return levels provide measures of the extent to which new equity can be sold in the industry, as well as determining the desirabliity of investing income retentions. If equity returns are adequate then the firm can obtain new equity, or

reinvest cash flows, without lowering the wealth of its stockholders. The picture for future equity financing is a mixed one: two carriers, Braniff and Delta, have produced substantial per share earnings. As the earlier discussion shows, Delta has accomplished this with substantially less debt per share than Braniff; and has not relied as heavily on tax deferral schemes. For these carriers - and Delta in particular - equity financing remains an easy source of funds. National, Northwest, and Western have provided positive returns to equity holders throughout the decade with two exceptions (NAL, 1971 and WAL, 1969). The critical question is one of trend here. While the 1975 results were not favorable, the return trends for these carriers are upward.

During the 1971-75 period four carriers exhibit improving equity returns if we abstract from 1975: National, Northwest, United and Western. However, since Northwest and United begin from extremely low bases, we must distinguish between the four. The growing equity returns for these carriers were not the result of leverage since liability-equity ratios remained relatively constant. In the case of National and Western, the return records are simply the result of increased operational profitability in the face of rising interest costs. Northwest and United produced equity return growth via different strategies, the former relying heavily on tax reductions via acceleration schemes, while the latter depended on efficiencies in operations and balance sheet management. Distinguishing again between the four carriers, we note that only National and Western

generated equity returns which would make retention investments attractive.

Equity returns at Pan Am have been persistently negative and do not warrant further discussion here. We turn instead to the remaining trunk carriers: American, Continental, Eastern, and TWA. All of these firms exhibit declining returns on equity in the 1971-75 period. While the rate of decline for AAL is almost imperceptible, the trend in the other cases is definite. However, the poor performance of these carriers can largely be laid to the following factors: first, persistently low return on assets. Second, all of these carriers maintained large revolving credit agreements with commercial banks during the period, and in most cases paid interest rates in excess of their return on assets. This performance has been such that it will be difficult indeed to attract new equity to these firms, much less to justify income retention should earnings improve in the near term. That both AAL and TWA appear in this group is a source of concern here, since these carriers hold a large proportion of the older craft in the trunkline fleet.

The leverage and coverage statistics discussed in Section F.2 go a long way toward describing risk associated with airline industry common stock. That is, high levels of debt relative to permanent capital imply high fixed charges, and low values of coverage ratios indicate possibilities of default on these charges. In recent years it has been suggested that the relation of changes in specific security returns relative to average shifts in the securities market

average returns provide a measure of the "risk" which is specific to a given firm. Define the following variables:

R_j: return on security j (dividend yield plus capital gain)

R_m: average return on a "market portfolio" composed of all securities.

Now, from the equation

$$R_j = \alpha_j + \beta_j R_m + \varepsilon_j \qquad (3)$$

we derive the following view of risk: the variance of returns on security j (σ_j^2) is the sum of systematic or market, influences ($\beta^2\sigma_m^2$) and firm-specific risk σ_ε^2. Accordingly, computed values of β_j derived from fitting (3) to prior years' experience are thought to express the relationship between risk in a given security and market risk, i.e., values for β_j in excess of unity indicate greater "systematic" risk in security j than in the portfolio of market securities, and vice versa. Stocks with computed values of β_j in excess of one thus rise faster than a bull market, and fall faster than a bear market returns.

One security research firm provides regular reports of a statistic very similar to the β in (3). This is the Value Line service which excludes dividend yield from its return definition. However, given the paucity of airline industry dividends, we have in the Value Line statistics a useful measure of risk in equity instruments. For the eleven carriers the computed values are:

Firm	β
AAL	1.45
BNF	1.60
CAL	1.60
DAL	1.35
EAL	1.45
NAL	1.70
NWA	1.60
PAA	1.50
TWA	1.85
UAL	1.60
WAL	1.60

As these coefficients are derived by least-squares of fits of (D-3) for the 60 months prior to October 1975, the values reported are random variables. Accordingly it is difficult to conclude that there exist important differences among these values. Rather these values are reported because of their excess over unity. On this measure of risk, airline equity investments are risky indeed. Note that the lowest estimate in the group is 1.35 - a value exceeded by only 118 of the 1600 firms in the Value Line sample. (Excepting the DAL figure, trunk air carriers constitute 8.5% of the 118 firms.)

F.4 REPLACEMENT FINANCING: PERSPECTIVE

The preceding remarks clearly document the disastrous financial performance of the domestic trunk airline industry, 1966-1975. The message in this record for replacement decisions is clearly negative. To wit, excess leverage has produced debilitating impacts on equity returns, and has raised borrowing costs to unusual levels.

Further debt financing thus appears an impossibility for all but a few carriers. Indeed, deteriorating coverage positions have raised serious questions as to the appropriateness of further leasing - and this in spite of the substantial tax incentives for such activity. Our work indicates equity financing (either through income retention or new stock issues) is the only serious approach to the massive replacement program. The same work shows that future equity funding requires much higher return rates than have previously been typical. These higher rates follow from several developments: (i) declining rates of return on assets produced by quantum jumps in fuel costs, (ii) increasing interest rates associated with excessive leverage, and (iii) investor uncertainty generated by deregulation discussion and uncertainty as to noise abatement retrofit, refanning, or replacement financing legislation.

The first quarter of 1977 saw these projections satisfied in a special sense. American Airlines - a carrier with a high degree of financial leverage and a relatively high proportion of older aircraft in its fleet - moved to begin replacement of its 707-100 aircraft. American's irregular return on equity, associated with high interest costs relative to return on assets, had made future debt financing nearly impossible. American offered 5 million shares of $2.1875 preferred stock (with 5 million warrants to purchase shares of its common stock at $14) for $25 per unit on March 20, 1977. The net proceeds of this issue were $18.5 million. The impact on American's balance sheet was substantial: debt declines from 41% to 37% of its

long-term capital structure. While it would be easy to over-state the impact of this move, it must nonetheless be viewed as signal. Later in 1977 EAL and TWA engaged in similar financing.

What is to be learned from the AAL example is simple. Debt must be reduced as a part of any major replacement program. Of course, this is inconsistent with the scale of the replacement task. It can only be concluded that such replacements as do occur will be well below the levels projected by numerous studies of industry capital "needs." Replacement of older aircraft will occur, and at more rapid rates among the less-levered, more profitable carriers. However, that replacement programs will be smaller than projections is the only reasoned conclusion which follows from an examination of the airline industry's financial performance.

APPENDIX A

INVENTORY OF COMMERCIAL JET FLEET, U.S. CARRIERS

Source: Ross, Commercial Jet Replacement Process, Northwestern University, The Transportation Center (1977)

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
U.S. TRUNK	747-100	9	9	1970	YES	6	15,000	5,200	1 100F; 2 100 F76
AMERICAN	720-B	3	0	1961	YES	15	30,000	15,400	10 Convert 720
	707-120B	48	48	1960	YES	17	54,000	27,000	23 Convert.120; Some for sale
	707-320B	10	10	1969	YES	7	25,000	9,800	
	707-320C	31	31	1963	YES	13	30,000	16,700	
	DC-8-50F	2	0	N/A	N/A	N/A	N/A	N/A	Leased to IAS Cargo AL
	DC-8-61F	1	0	N/A	N/A	N/A	N/A	N/A	Leased to Spantex
	727-100	57	57	1964	YES	12	32,000	27,600	
	727-200	55/9	55	1968	YES	8	23,000	18,900	(Is on order ORT 75)
	DC-10-10	25	25	1971	YES	5	12,000	6,000	(11 options dropped)
	CV-990A	4	0	1962	YES	14	-	-	Leased to Spantex
BRANIFF	747-100	1	1	1969	YES	7	27,000	4,400	
	DC-8-50	4	4	1973	NO	14	46,000	16,600	
	DC-8-62	6	6	1967	YES	9	33,000	11,900	
	DC-8-62F	1	1	1967	YES	9	33,000	11,900	
	727-100	12	12	1966	YES	10	32,000	29,800	
	727-100Q/C	17	17	1966	YES	10	33,000	30,900	
	727-200	44	44	1970	YES	6	24,000	23,200	
	BAC-111	-	-	-	-	-	-	-	Corporate Aircraft
CONTINENTAL	720B	5	5	1962	YES	14	52,000	36,500	
	727-100Q/C	1	1	1967	YES	9	21,000	18,500	
	727-200	36/1	36	1968	YES	8	27,000	24,500	
	DC-10-10	8	8	1972	YES	4	16,000	8,200	
	DC-10-10CF	8	8	1974	YES	2	9,000	3,800	
DELTA	747-100	3	3	1970	YES	6	17,000	8,000	Sold to Boeing
	DC-8-50	19	5	1960	YES	17	54,000	35,600	All for sale (6 Units Converted 8-10
	DC-8-61	13	13	1967	YES	9	31,000	20,800	
	727-100	5	5	1972	NO	11	31,000	21,400	Acquire NE Merger
	727-200	71/18	71	1972	YES	8	25,000	18,500	First Units acquired NE Merger
	DC-9-30	62	62	1967	YES	9	27,000	34,000	
	L-1011	17/2	19	1973	YES	3	7,000	5,500	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
EASTERN	727-100	46	46	1963	YES	13	35,000	32,000	
	727-100Q/C	25	25	1966	YES	10	31,000	23,500	
	727-200	42	42	1969	YES	7	20,000	15,800	
	DC-9-10	9	9	1966	YES	10	26,000	24,200	Return to DACO 1978
	DC-9-30	72	72	1967	YES	9	23,000	21,900	
	DC-8-20/30	3	0	1960	YES	16	41,000	19,700	Repossessed
	L-1011	29/6	29	1972	YES	4	10,000	5,700	2 Sold Cathay Pacific
	DC-8-61	5	0	-	-	-	-	-	2 Leased Capitol, 2 JAL
NATIONAL	747-100	2	0	1970	YES	6	16,000	5,000	Sold to NW
	727-100	13	13	1964	YES	12	29,000	31,500	
	727-200	25	25	1968	YES	8	23,000	23,500	
	DC-8-20/30	1	0	1963	NO	16	N/A	N/A	NWAC leased to OV
	DC-10-10	11	11	1971	YES	5	12,000	7,000	
	DC-10-30	4	4	1973	YES	3	10,000	3,000	
NORTHWEST	DC-10-40	22	22	1972	YES	4	9,000	6,000	
	747-100	12	10	1970	YES	6	20,000	6,600	
	747-200B	5	5	1971	YES	5	17,800	5,400	
	747-200F	3	3	1975	YES	1	-	-	
	707-320B	5	5	1963	YES	13	24,000	10,700	
	707-320C	3	3	1964	YES	12	22,000	9,800	Surplus
	727-100	20	15	1964	YES	12	26,000	27,300	Some for sale
	727-100Q	12	12	1966	YES	10	22,000	22,900	
	727-200	31/4	31	1968	YES	8	17,000	16,800	
PAN AM	747-100	32	32	1969	YES	7	23,000	6,300	Two are Freighters
	747-200C	2	2	1974	NO	5	12,000	2,800	Sublease World AW
	747SP	5	5	1975	YES	1	-	-	
	707-320B	51	51	1962	YES	14	50,800	17,475	
	707-320C	19	19	1963	YES	13	45,000	15,800	
	727-100	11	11	1965	YES	11	23,000	26,500	
	727-100Q	2	2	1966	YES	10	22,000	25,600	
	707-320	2	0	1959	YES	17	42,000	14,700	For Sale
TWA	747-100	10	10	1969	YES	7	22,000	4,800	
	707-120B	40	40	1962	YES	14	47,000	19,400	
	707-320B	36	36	1962	YES	14	50,000	14,600	
	707-320C	15	15	1963	YES	13	39,000	15,100	
	727-100	27	27	1964	YES	12	31,000	22,100	
	727-100Q	8	8	1967	YES	9	24,000	17,800	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
TWA Cont'd	727-200	39/14	39	1968	YES	8	22,000	21,200	Delivery deferred
	DC-9-10	19	19	1966	YES	10	20,000	20,600	
	707-320	10	10	1959	YES	17	57,000	18,100	
	L-1011	30	30	1972	YES	4	9,000	3,900	2 Sold to Saudi, More for Sale
	CV-880	25	0	1960	YES	17	-	-	Grounded, For Sale
UNITED	747-100	18	18	1970	YES	6	19,000	4,600	
	DC-8-50	16	16	1961	YES	15	52,000	22,900	6-1-63 5 Converted from 10's
	DC-8-50F	15	15	1964	YES	12	31,000	13,600	
	DC-8-61	30	30	1967	YES	9	29,000	11,900	
	DC-8-62	9	9	1969	YES	7	22,000	7,300	
	727-100	86	86	1963	YES	13	31,000	24,903	
	727-100Q	36	36	1966	YES	10	29,000	20,600	
	727-200	28	28	1968	YES	8	19,000	16,900	
	737-200	59	57	1968	YES	8	14,000	21,600	Two leased out
	DC-8-20-30	31	30	1960	YES	16	52,000	25,000	15 Converted from 10's 61-63
	720	4	0	N/A	N/A	N/A	N/A	N/A	Not operable
	DC-10-10	37	37	1971	YES	5	13,000	6,500	
WESTERN	720B	18	18	1961	YES	15	43,000	31,000	
	707-320C	5	5	1968	YES	8	29,000	9,500	
	727-200	21/5	21	1969	YES	9	18,000	13,200	
	737-200	24	24	1968	YES	8	19,000	24,800	
	DC-10-10	7	7	1973	YES	3	11,000	4,200	
REGIONAL/LOCAL SERVICE									
AIR CALIF	737-200	8	8	1968	YES	8	19,000	32,500	One on sublease to Aloha
ALASKA	727-100	5	5	1969	NO	13	26,000	27,100	Lease PSA; pur. PA
	727-100Q	3	4	1966	YES	10	28,000	22,900	
ALLEGHENY	DC-9-30	43	43	1967	YES	9	26,000	34,600	
	DC-9-50	8	8	1975	YES	1	1,000	1,000	
	BAC-111-200	31	31	1972	NO	11	32,000	42,000	EX, BN, Mohawk

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
ALOHA	737-100	2	2	1973	NO	8	11,000	19,800	EX AVIANCA
	737-200	4	4	1969	YES	7	14,000	38,000	2 UA
FRONTIER	737-200	19	19	1969	YES	7	20,000	24,900	5 Used
HAWAIIAN	DC-9-30	4	4	1967	YES	9	17,000	25,500	
	DC-9-30F	1	1	1972	NO		20,000	30,000	Lease OV
	DC-9-50	8	8	1975	YES	1	2,000	3,000	
HUGHES AIR	DC-9-10	4	4	1968	YES	8	25,000	36,800	
	DC-9-10F	12	11	1973	NO	8	25,000	34,900	EX CO
	DC-9-30	17	17	1968	YES	6	24,000	33,800	
	B727-200	0/3	-	-	-	-	-	-	
NORTH CENTRAL	DC-9-30	21	21	1967	YES	9	21,000	35,100	
	DC-9-50	3/3	3	1976	-	-	-	-	
OZARK	DC-9-10	6	4	1966	YES	10	23,000	37,500	
	DC-9-30	19	18	1968	YES	8	22,000	33,900	
PACIFIC SW	727-200	22	22	1967	YES	9	20,000	31,200	
	737-200	3	3	1968	YES	8	16,000	24,900	
	L-1011	2/3	0	1974	YES	2	1,000	1,800	2 Grounded; 3 Order Dispute
PIEDMONT	737-200	19	19	1968	YES	8	20,000	32,100	
SOUTHERN	DC-9-10	21	21	1967	YES	9	29,000	50,800	
	DC-9-30	6	6	1969	YES	7	19,000	27,400	
SOUTHWEST	737-200	5	5	1971	YES	5	12,000	17,900	
TEXAS INT.	DC-9-10	13	13	1966	YES	10	25,000	33,800	
	DC-9-10F	3	3	1967	YES	9	25,000	33,800	
	DC-9-30	5	5	1969	YES	8	19,000	24,500	
WIEN AIR	737-200Q	7	7	1968	YES	8	14,000	16,800	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
SUPPLEMENTAL/CARGO									
AIRLIFT INT	DC-8-50F	2	2	1967	YES	9	45,000	21,600	
	DC-8-63F	3	3	1968	YES	8	30,000	9,000	
	727-100Q	1	0	1967	YES	9	26,000	14,700	Leased out
	707-300	2	0	-	-	-	-	-	Leased to Aerolineas Argentinas
CAPITOL INT	DC-8-61	2	2	1971	NO	9	27,000	8,100	PUR. fm NA
	DC-8-63F	2	1	1968	YES	8	25,000	7,500	One lease OV
	DC-8-20/30	4	4	1967	NO	16	52,000	25,000	EX BN, EX NA
FLYING TIGER	747-100F	3/3	3	1974	NO	7	16,000	5,100	
	DC-8-63F	14	14	1968	YES	8	28,000	8,400	
McCULLOCH INT	DC-8-20/30	1	0	1975	NO	17	43,000	19,800	EX UA
	B720	3	3	1975	NO	-	-	-	
OVERSEAS NAT	DC-8-61F	2	2	1972	NO	8	26,000	6,500	
	DC-8-63F	2	2	1968	YES	8	29,000	7,300	
	DC-9-30F	4	4	1967	YES	9	25,000	22,000	
	DC-8-20/30	6	4	1973	NO	16	46,000	13,800	2 Cannibalized
	DC-10-30F	0/2	0	1973	YES	-	-	-	Del 1977
SATURN	DC-8-61F	1	0	-	-	-	-	-	Leased to Seaboard Wld
SEABOARD WLD	747-200F	2	2	1974	YES	2	8,000	1,800	
	DC-8-50F	1	1	1964	YES	11	37,000	10,400	
	DC-8-61F	5	5	1973	NO	9	32,000	8,000	
	DC-8-63F	5	5	1968	YES	8	34,000	8,500	
TRANS INT	DC-8-63F	6	6	1968	YES	8	29,000	7,300	
	DC-10-30F	3	3	1973	YES	3	11,000	2,700	
	DC-8-61	1	0	-	-	-	-	-	Leased to Seaboard Wld
WORLD	747-200C	3	1	1973	YES	3	10,000	2,200	1 Sublease PA; 1 Sublease Korean
	DC-8-63F	6	6	1971	YES	7	28,000	7,300	
	747-100Q	4	0	1967	YES	9	27,000	17,000	Leased to PSA

APPENDIX B

INVENTORY OF NON-U.S. COMMERCIAL JET FLEET (Free World Only)

Source: Ross, Commercial Jet Replacement Process, Northwestern University, The Transportation Center

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
CANADA									
AIR CANADA	747-100	5	5	1971	YES	5	14,000	4,600	
	747-200B	1	1	1975	YES	1	4,000	1,700	
	DC-8-50	2	2	1968	YES	8	24,000	11,500	
	DC-8-50F	5	5	1963	YES	13	41,000	15,200	
	DC-8-61	7	7	1967	YES	9	25,000	9,800	
	DC-8-63	12	12	1969	YES	7	22,000	8,600	
	727-200	14	14	1974	YES	2	4,000	5,200	
	DC-9-10F	8	8	1972	NO	9	22,000	33,400	Ex CO
	DC-9-30	44	44	1967	YES	9	22,000	21,600	
	DC-9-30F	1	1	1973	NO	9	21,000	18,600	Ex OV Nat'l
	L-1011	10	10	1973	YES	3	8,000	4,100	
	DC-8-40	11	8	1960	YES	16	45,000	20,700	
CP AIR	747-200B	4	4	1975	YES	1	8,000	2,600	
	DC-8-50	1	1	1966	YES	10	40,000	12,400	
	DC-8-50F	1	1	1967	NO	10	35,000	10,850	Ex PG
	DC-8-63	5	5	1968	YES	8	37,000	10,700	
	727-100	4	4	1970	YES	6	20,000	15,100	
	727-200	2	2	1975	YES	1	3,000	2,300	
	737-200	7	7	1971	YES	4	24,000	18,600	
	DC-8-40	5	4	1961	YES	15	61,000	18,900	
EASTERN PRO	737-200	7	7	1969	YES	7	17,000	27,300	
NORDAIR	DC-8-61F	1	1	1973	NO	9	31,000	14,900	Lease from TIA
	737-200	1	1	1969	YES	7	12,000	10,400	
	737-200C	5	5	1968	YES	8	21,000	13,500	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
PACIFIC WEST	707-120B	1	1	1967	NO	15	50,000	20,600	Ex Quantas
	707-320C	1	1	1972	NO	11	37,000	13,000	Ex NW
	727-100Q	2	2	1972	NO	8	22,000	13,600	Ex Air Asia, TIA
	737-200	10	10	1968	YES	8	14,000	26,300	
	737-200C	1/1	1	1969	YES	7	19,000	23,400	
QUEBECAIR	727-100	1	1	1974	NO	12	30,000	25,000	Ex EA
	BAC-111-300	3	3	1969	NO				Ex British Eagle, Phil. Air
TEMPAIR	707-220/320	1	1	1974	NO	16	54,000	19,900	Ex PA
WARDAIR	747-100	2	2	1973	YES	5	16,000	5,300	Ex CO
	707-320C	2	2	1968	YES	8	17,000	11,800	
INTERNATIONAL									
AEROCONDOR	720B	2	2	1972	NO	15	38,000	21,176	Ex AA
COLUMBIA	707-120B	1	1	1975	NO	-	-	-	
AERO PERU	DC-8-50	3	3	1974	NO	14	55,000	13,800	Ex BIASA, KLM
	727-100	1	1	1974	NO	13	35,000	30,100	Ex EA
	F28	3/1	3	1974	NO				Merger SATCO
AERO TRANSPORT ITALIANI	DC-9-30	16	16	1969	YES	7	13,000	19,500	
AERO MEXICO	DC-8-50	5	5	1962	YES	14	42,000	21,000	1 EX NA
	DC-9-10	9	9	1967	YES	9	26,000	26,000	
	DC-9-30	7	7	1974	YES	2	7,000	7,000	
	DC-10-30	2	2	1974	YES	2	9,000	3,300	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
AER QUISQUE-YANAS	DC-8-20/30	2	0	1974	NO	6	39,000	14,800	Ex JA
	707-200	2	2	1974	NO	15	40,000	14,000	Ex PA
AFFRETAIR (GABON)	DC-8-50F	2	2	1972	NO	11	44,000	11,000	Ex SB, CA
AFRICAN SAFARI	DC-8-20/30	1	1	1973	NO	16	48,000	12,000	Ex Martinair
AIR AFRIQUE	DC-8-50	2	2	1963	YES	13	43,000	15,300	
	DC-8-50F	3	3	1966	YES	10	45,000	16,700	
	DC-8-63F	1	1	1970	YES	6	23,000	5,800	
	Caravelle 10R	1	1	1973	NO	11			Ex Alia Roy Jordan
	Caravelle 11R	2	2	1967	YES	9			
	DC-8-20/30	1	1	1967	NO	15	48,000	18,200	Ex UTA
	DC-10-30	2	2	1973	YES	3	10,000	4,100	
AIR ALGERIE	727-200	4	4	1971	YES	5	14,000	9,200	
	737-200	6	6	1970	YES	6	12,000	8,300	
	737-200C	2	2	1972	YES	4	10,000	7,600	
	Caravelle 3	3	3	1960	YES	16			
	Caravelle 6	1	1	1961	YES	15			
AIR BRUNEI (BORNEO)	737-200	2	2	1975	YES	1	2,000	500	
AIR CENTRA-FRIQUE	Caravelle 6R	2	2	1975	NO	14			Ex Sterling
AIR CEYLON	DC-8-50	1	1	1972	NO	16	51,000		Ex UTA (NW)
	HS-121-1E	1	1	1969	YES	7			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
AIR CHARTER	727-200	2	2	1971	NO	9	18,000	22,800	Ex PCC, SW
INT'L FRANCE	Caravelle 3	5	4	1971	NO	13			Ex Air France
AIR FRANCE	747-100	14	14	1970	YES	6	21,000	6,000	
	747-200F	1	1	1974	YES	2	6,000	1,200	
	707-320B	6	6	1962	YES	14	46,000	14,000	
	707-320C	11	11	1965	YES	11	36,000	8,000	
	727-200	20	20	1968	YES	8	16,000	15,300	
	737-200	2	2	1973	NO	8	16,000	20,800	Ex WA
	707-220/230	17	17	1959	YES	17	47,000	14,200	
	747-200F(GE)	0/1	0	-	YES	-	-	-	
	A300	7	7	1975	YES	1	3,000	2,600	
	Concorde	0/4	2	1975	YES	-	-	-	
	Caravelle 3	36	33	1959	YES	17			
AIR INTER FRANCE	Caravelle 12	5	5	1972	YES	6			
	Mercure 100	9/1	9	1974	YES	2			
	Caravelle 3	17	17	1967	YES	9			
AIR INDIA	747-200B	5	5	1971	YES	5	16,000	6,600	
	707-320B	3	3	1964	YES	12	35,000	14,600	
	707-320C	2	2	1967	YES	9	30,000	12,400	
	707-420	4	4	1960	YES	16	51,000	22,600	
AIR HAITI	DC-8-20/30	2	0	1973	NO	16	40,000	15,600	Ex EA
AIR JAMAICA	DC-8-50	3	3	1971	NO	14	40,000	15,600	Ex EA
	DC-8-61	2	2	1969	NO	9	25,000	6,300	Ex EA
	DC-8-62	1	1	1973	NO	7	22,000	5,500	Ex EA
	727-200	5	5	1974	YES	2	4,000	3,800	
	DC-9-30	3	3	1969	YES	7	16,000	8,000	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
AIR MADAGASCAR	737-200	2	2	1969	YES	7	10,000	10,100	
AIR MALI	727-100Q	1	1	1971	NO	9	17,000	12,400	Ex WLD
AIR MALTA	720B	2	2	1974	NO	16	43,000	20,500	Lease from Pakistan Int'l
	BAC-111-500	1	1	1975	NO	10			Lease from B. CAL
AIR MICRONESIA	727-100Q	2	2	1968	NO	9	23,000	15,500	
AIR NAURU	737-200Q	1	1	1975	YES	1	-	-	
AIR NEW ZEALAND	DC-8-50	6	6	1965	YES	16	52,000	23,900	2 Ex UA
	DC-10-30	7	7	1973	YES	3	14,000	3,700	
AIR PANAMA	727-100	3	3	1972	NO	11	20,000	19,000	Ex All Nippon
AIR RHODESIA	720	3	3	1973	NO	May Not Be Operable Any More Ex CAL Air			
AIR SIAM	747-100	1	1	1973	NO	5	11,000	5,100	Lease Air Linguis
	DC-10-10CF	1	1	1974	YES	2	6,000	1,600	
	A300B2	1	0	1974	YES	2	-	-	No Longer Operable
AIR SPAIN	DC-8-20/30	2	0	1971	NO	16	41,000		Ex EA
AIR VIETNAM	727-100Q	1	0	1968	NO	-	-	-	Ex PA
AIR VIKING (ICELAND)	720	3	3	1974	NO	16	32,000	19,000	Ex UA (May Not Be Operable)

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
AIR ZAIRE (Air Congo)	DC-8-63F	2	2	1970	YES	6	9,000		
	737-200C	3	3	1973	YES	3	5,000	5,300	
	Caravelle 11R	2	2	1967	YES	9			
	DC-8-20/30	2	2	1967	NO	16	40,000	16,000	Ex PA
	DC-10-30	2	2	1974	YES	2	5,000	2,000	
ALIA JORDAN	720B	2	2	1972	NO	16	38,000	23,800	Ex PA
	707-320C	6	6	1971	YES	13	42,000	12,700	2 Ex PA
	727-200	3	3	1974	YES	2	5,000	4,400	
ALISARDA (Italy)	DC-9-10	2	2	1974	NO	10	26,000	41,600	Ex Southern
	DC-9-30	0/2	-	-	-	-	-	-	
ALITALIA	747-100	2	2	1970	YES	6	21,000	4,300	
	747-200B	3	3	1971	YES	5	18,000	4,900	
	DC-8-62	8	8	1967	YES	9	30,000	7,500	
	DC-8-62F	2	2	1968	YES	8	28,000	7,000	
	DC-9-30	33	33	1967	YES	9	18,000	18,000	
	DC-9-30F	3	2	1968	YES	8	14,000	14,000	
	DC-10-30	8	8	1973	YES	3	11,000	4,600	
	DC-8-40	11	6	1960	YES	16	49,000	20,000	
	Caravelle 16N	14	11	1960	YES	16			
ALL NIPPON	727-200	26	26	1969	YES	5	16,000	15,000	
	737-200	14	14	1969	YES	7	17,000	17,400	
	L-1011	15/8	15	1973	YES	3	5,000	3,800	
ALM DUTCH ANTILLES	DC-9-30	3	3	1975	YES	1	3,000	2,500	
ALYMEDA S. YEMEN	720B	1	1	1974	NO	16	Not Reported		Ex AA
ANSETT AIR-LINES (Australia)	727-100	4	4	1964	YES	12	39,000	28,000	
	727-100Q	2	2	1969	YES	7	24,000	16,900	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
	727-200	7	7	1972	YES	4	13,000	9,200	
	DC-9-30	12	12	1967	YES	9	25,000	24,300	
	F28	5	5						
ARIANA	720B	1	1	1973	NO	16	36,000	19,000	Ex PA
AFGHAN	727-100Q	2	2	1968	YES	7	16,000	8,800	Ex Jet Av
AEROLINEAS	747-100	1	1	1975	NO	6	13,000	6,800	Lease from mfr
ARGENTINAS	707-320B	5	5	1966	YES	10	33,000	9,500	(Ex Delta
	707-320C	4	4	1968	YES	8	29,000	8,500	
	737-200	10	10	1970	YES	6	16,000	18,700	
	737-200Q	2	2	1970	YES	6	14,000	16,300	
	F28	3	3	1975	YES	1			
	747-200B	0/1	-	-	-	-	-	-	
AUSTRIAN	DC-9-30	9	9	1971	YES	5	17,000	17,000	
	DC-9-50	2	2	1976	YES	1	2,000	2,000	
	Caravelle 6	3	3	1963	YES	13			
AUENSA VENEZUELA	DC-9-10	1	1	1967	YES	9	?	?	
AVIACO, SPAIN	DC-8-50	5	5	1973	NO	16	40,000	20,000	Lease from IB
	DC-8-50F	1	1	1973	NO	13	38,000	19,000	Lease from Capitol
	DC-9-30	8	8	1974	YES	2	5,000	3,200	
	DC-9-30F	0/4		-	-	-	-	-	
	Caravelle 10R	4	4	1973	NO	10			Ex IB
	Caravelle 6	5	4	1972	NO	14			EX IB

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
AVIANCA	720B	7	7	1961	YES	16	40,000	17,400	
COLUMBIA	707-320B	2	2	1968	YES	8	29,000	11,800	
	727-100	8	8	1966	YES	10	22,000	25,200	
	727-100Q	2	2	1971	NO	8	13,000	13,800	Ex CO
BALAIR,	DC-8-50F	1	1	1971	NO	10	38,000	9,500	Ex Universal
SWITZERLAND	DC-8-63	1	1	1973	NO	7	26,000	6,500	Ex EA
	DC-9-30F	1	1	1970	YES	6	12,000	6,500	
BANGLADESH									
BIMAN	707-320C	1	1	1973	NO	10	23,000	10,300	
BRAATHENS,	737-200	5/1	5	1969	YES	7	25,000	16,700	
NORWAY	737-200C	1	1	1971	YES	4	17,000	14,600	
BRITANNIA,	737-200	11/2	11	1968	YES	8	25,000	15,100	
U.K.	737-200C	2	2	1970	YES	6	20,000	10,700	
BRITISH	707-320C	11	11	1967	YES	9	49,000	10,400	
CALEDONIAN	707-320	1	1	?	?	?	53,000	19,700	
	BAC-111-200	7	7	1965	YES	11			
	BAC-111-500	11	11	1969	YES	7			
BRITISH	747-100	17/1	17	1970	YES	6	19,000	5,700	
AIRWAYS	707-320B	2	2	1970	YES	6	18,000	5,300	
(OVERSEAS	707-320C	9	9	1965	YES	11	37,000	12,100	
DIVISION)	Concorde	1/4	1	1976	YES	-	-	-	
	747-200B(RR)	0/4	-	-	-	-	-	-	
	VC-10 Std.	4	4	1964	YES	12			
	VC-10 Super	15	15	1965	YES	11			
	707-420	8	6	1960	YES	16	56,000	19,500	
	Comet	2	0	1959	YES	17	-	-	Scrapped
(EUROPEAN	L-1011	7/8	7	1974	YES	2	2,000	2,000	
DIVISION)	BAC-111-500	18	18	1968	YES	8			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
	HS-121-1C	20	20	1963	YES	13			
	HS-121-2E	15	15	1968	YES	8			
	HS-121-3B	26	26	1974	YES	2			
BRITISH WEST	707-120B	2	2	1969	NO	14	37,000	21,900	Ex Quantas
INDIAN AIRWAYS	707-320C	4	4	1974	NO	10	26,000	11,600	Ex NW
TRINIDAD (BWIA)	707-220	4	2	1971	NO	17	45,000	25,900	Ex BN (All for Sale)
CAAC, CHINA	707-320B	4	4	1975	YES	1	2,000	1,000	
	707-320C	6	6	1975	YES	1	2,000	1,000	
	HS-121-1E	3	3	1970	NO				Ex Pakistan Int'l
	HS-121-2C	18/15	18	1972	YES	4			
	HS-121-3B	2	2	1974	YES	2			
CAMERON AIR	707-320C	1	1	1972	YES	4	7,000	2,200	
	737-200Q	2	2	1972	YES	4	7,000	11,800	
CARGOLUX, LUXEMBURG	DC-8-83F	3	3	1973	NO	8	28,000	7,000	1 purchased from FT 2 lease from SB
CATHAY PACIFIC	707-320B	4	4	1971	NO	13	43,000	19,600	Ex NW
HONG KONG	707-320C	8	8	1972	NO	12	38,000	14,900	Ex NW
	L-1011	2	2	1975	YES	1	2,000	1,500	
	CV-880 M	0	0	1962	YES	14	-	-	May have been sold 75
CHOAN AIRLINES	747-100	1	1	1975	NO	6	19,000	9,500	Lease from mfr. (Ex Delta)
TAIWAN	707-320B	1	1	1971	NO	13	42,000	18,100	Ex NW
	707-320C	5	5	1969	YES	7	48,000	14,800	3 Ex CO
	727-100	2	2	1967	YES	9	24,000	16,400	
	727-100Q	1	1	1969	YES	7	20,000	13,100	
	Caravelle 3	2	2	1971	NO	16			Ex SAS

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
CONAIR, DENMARK	720	5	4	1971	NO	15	38,000	23,500	From mfr. (Ex EA)
CONDOR	747-200B	2	2	1971	YES	5	15,000	4,000	
FLUGDIENST	707-300B	1	1	1969	NO	12	39,000	13,800	Lease from Lufthansa
GERMANY	727-100	7	7	1965	NO	12	29,000	18,800	Ex Lufthansa
	727-200	8	8	1973	YES	3	8,000	7,800	
CRUZEIRO, BRAZIL	727-100	8	8	1971	YES	12	32,000	15,700	1 Sabena, 1 Wardair, 2 Ex EA, 1 Hughes
	737-200	6	6	1971	YES	1	2,000	2,100	
	Caravelle 6	6	0	May have been traded in 70 Boeing for 737s.					
CYPRUS	DC-9-10	2	2	1975	NO	10	21,000	23,100	Ex KL
	HS-121-2E	2	1	1969	YES	7			
	BAC-111-500	1	1	1974	NO	6			Lease from Courtline
DELTA (BELGIUM)	720	1	1	?	NO	15	33,000	20,000	May not be operable
DAN AIR U.K.	727-100	5	5	1972	NO	11	25,000	19,800	Ex JAL
	707-320	2	2	1971	NO	17	54,000	19,100	Ex PA
	BAC-111-200	2	2	1975	NO	10			Ex Zambia
	BAC-111-300	2	2	1969	NO				Ex British Eagle
	BAC-111-400	3	3	1969	NO	11			Ex AA, Bauaria
	BAC-111-500	4	4	1971	NO	7			Lease from mfr. (Ex Courtline)
	Comet 4BK	16	9	1966	NO	16			Ex BOAC
D.E.T.A.	737-200	3	3	1970	YES	6	13,000	12,500	
MOZAMBIQUE	737-200Q	1	1	1971	YES	5	9,000	8,300	
DOMINICANA	727-100	1	1	1972	YES	4	6,000	3,100	
	727-200	1	1	1975	YES	1	3,000	1,700	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
EAST AFRICAN AIRWAYS	707-320C	1	1	1974	NO	11	29,000	16,300	Ex AA
	DC-9-30	3	3	1971	YES	5	11,000	11,000	
	VC-10 Super	4	4	1966	YES	10			
ECUATORIAN	720B	3	3	1974	NO	15	30,000	17,700	Ex PA (May be out of service)
	Caravelle	2	2						
EGYPTAIR (UNITED ARAB)	707-320C	9	9	1968	YES	8	23,000	9,600	
	737-200	2/5	2	1974	YES	2	13,000	-	1 Lease
	Comet	4	0	1964	NO	6	-	-	Ex UAA
EL AL	747-200B	3	3	1971	YES	5	15,000	3,000	
	747-200C	1	1	1975	YES	1	-	-	
	720B	2	2	1962	YES	14	41,000	17,100	
	707-320B	3	3	1966	YES	10	49,000	13,900	
	707-320C	2	2	1965	YES	7	25,000	6,100	
	707-420	3	3	1961	YES	15	51,000	15,500	
ETHIOPIAN AIRLINES	720B	4	4	1962	YES	14	51,000	32,400	2 Ex CO, AL
	707-320C	2	0	-	-	-	-		Leased to Saudi Arabian Airlines
FAUCETT, PERU	727-100	1	1	1968	YES	8	20,000	25,800	
	BAC-111-475	2	2	1971	YES	5			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
FINNAIR	DC-8-62	1	1	1975	NO	8	30,000	9,900	Ex UT
	DC-8-62F	2	2	1969	YES	7	26,000	6,500	
	DC-9-10	7	7	1969	NO	10	23,000	34,500	Ex Air Canada
	DC-9-10F	2	2	1972	NO	9	20,000	30,000	Ex Texas Int'l
	DC-9-50	3/3	3	1976	YES	-	-	-	
	Caravelle 10B	9	9	1964	YES	12			
	DC-10-30	2	2	1975	YES	1	5,000	1,600	
GARUDA INDONESIAN	DC-8-50	3	3	1965	NO	14	54,000	21,600	Ex KLM
	DC-9-30	12	12	1969	YES	7	17,000	13,300	
	DC-10-30	2	2	1973	NO	1	1,000	4,000	Lease KLM (New one this year)
	F-28	16	16	1971	YES	5			
HAPAG-LLOYD FLUG (W. GER)	727-100	8	8	1972	NO	12	24,000	23,000	Ex All Nip, Pacific S.W., Sabena, TOA, JAL
IBERIA	747-100	2	2	1970	YES	6	16,000	3,400	
	747-200B	1	1	1972	YES	4	14,000	2,900	
	DC-8-50F	1	1	1968	YES	8	21,000	9,500	
	DC-8-63	5	5	1968	YES	8	26,000	6,500	
	DC-8-63F	1	1	1968	YES	8	24,000	6,000	
	727-200	29	29	1972	YES	4	9,000	8,800	
	DC-9-30	31	31	1967	YES	9	19,000	20,000	
	DC-9-30F	3	3	1973	YES	3	10,000	10,500	
	DC-10-30	6	6	1973	YES	3	9,000	2,800	
	F-28	2	2	1970	YES	6			
	DC-8-50	1	1	1961	YES	10	28,000	12,600	
ICELANDAIR	727-100Q	2	2	1967	YES	10	20,000	10,900	1 Ex AA
ICELANDIC	DC-8-63F	3	3	1970	NO	8	37,000	9,300	Lease from SB

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
INDIAN AIRLINES CORP.	737-200	12/1	12	1970	YES	6	13,000	13,100	
	A300	0/3	-	-	-	-	-	-	
	Caravelle 6	6	8	1963	YES	13			
INER AORIA, YUGOSLAVIA	DC-9-30	3/1	3	1969	YES	7	12,000	8,500	1 Ex Purdue Fluof Pan Aoria
	DC-9-30F	2	2	1971	YES	5	18,000	12,800	1 Ex ONA
INVICTA (GR BR)	720B	2	2	1974	NO	13	35,000	17,500	Ex AA
IRANAIR	747SP	0/3	-	-	-	-	-	-	
	747-200B	0/2	-	-	-	-	-	-	
	707-320B	1	1	1975	NO	11	37,000	12,700	Ex PA
	707-320C	5	4	1970	YES	6	34,000	12,300	2 Ex PA
	727-100	4	4	1965	YES	11	25,000	19,100	1 Ex All Nippon
	727-200	5	5	1974	YES	2	5,000	3,900	
	737-200	2	2	1971	YES	5	11,000	18,500	
	737-200C/QC	2	2	1971	YES	5	10,000	16,500	
IRISH INT'L AER LINGUS	707-320C	4	4	1964	YES	12	37,000	13,700	
	737-200	3	3	1969	YES	7	15,000	16,100	Lease from VA (1)
	737-200C/QC	4	4	1969	YES	7	13,000	18,300	
	BAC-111-200	4	4	1965	YES	11			
	747-100	1	0	1970	-	-	-	-	Lease to Air Siam
IRAQI	747-200C	0/2	-	-	-	-	-	-	
	707-320C	3	3	1974	YES		3,000	2,300	
	727-200	2/1	2	1976	-	-	-	-	
	737-200C/QC	1/1	1	1975	YES	1	2,000	2,400	
	HS-121-1E	3	2	1965	YES	11			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
KOREAN AIRLINES	747-200B	2	2	1973	YES	3	10,000	2,500	
	747-200C	1	1	1974	NO	3	8,000	1,500	Sublease from World
	707-320C	4	4	1971	YES	11	34,000	12,100	2 Leased from World; 1 purchased from World
	DC-8-63F	1	1	1972	NO	7	24,000	7,200	Lease from SB
	727-100	3	3	1972	NO	10	23,000	22,500	2 Leased from JAL; 1 purchased from JAL
	720	2	2	1969	NO	15	37,000	25,200	Ex EA
	DC-10-30	3	3	1975	YES	1	5,000	1,000	
	A300B4	2/4	2	1975	YES	1	-	-	
KUWAIT AIRWAYS	707-320C	7	7	1968	YES	10	22,000	10,500	1 Ex PA
	737-200	1	1	1976	YES	-	-	-	
	HS-121-1E	1	1	1966	YES	10			
LAB, BOLIVIA	727-100	2	2	1969	YES	7	31,000	29,600	1 Ex BN
	727-100C/QC	1	1	1974	NO	8	16,000	10,500	Ex Trans Int'l
	727-200	1	1	1975	YES	1	1,000	1,000	
LAKER AIRWAYS U.K.	707-120B	2	2	1969	NO	16	48,000	20,800	Ex Quantas
	DC-10-10	3	3	1972	YES	4	9,000	2,600	
	BAC-111-300	5	5	1967	YES	9			
LAN-CHILE	707-320B	2	2	1967	NO	13	52,000	16,000	Ex Lufthansa
	707-320C	2	2	1969	YES	10	27,000	11,100	1 Ex NW
	727-100	1	1	1968	YES	8	20,000	11,000	
	727-100C/QC	3	3	1968	YES	8	22,000	10,500	
	Caravelle 6	3	3	1964	YES	12			
LAV, VENEZUELA	DC-9-10	4	4	1968	YES	9	20,000	30,000	3 Ex Saudia
	DC-9-30	1	1	1970	NO	9	20,000	20,000	Ex Pacific Southwest

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
LIBYAN ARAB	707-320C	0/1	-	-	-	-	-	-	
	727-200	4/2	4	1970	YES	6	12,000	7,500	
	Caravelle 6	3	3	1965	YES	15			1 Ex UA
LTU,GERMANY	Caravelle 10R	4	4	1967	YES	9			
	L-1011	2	2	1973	YES	3	9,000	4,700	
	SPEY-JR-F28	2	0	1967	YES	9			May have been sold to mfr.
LUFTHANSA	747-100	2	2	1970	YES	6	23,000	5,700	
	747-200B	2	2	1971	YES	5	20,000	3,900	
	747-200F	1	1	1972	YES	4	18,000	3,900	
	707-320B	9	9	1963	YES	13	49,000	12,900	
	707-320C	6	6	1965	YES	11	48,000	11,500	
	727-100C/QC	11	11	1967	YES	9	24,000	27,900	
	727-200	19	19	1971	YES	5	12,000	7,500	
	737-100	22	22	1967	YES	9	18,000	28,200	
	737-200C/QC	6	6	1969	YES	7	10,000	13,300	
	747-200B	0/1	-	-	-	-	-	-	GE engine
	DC-10-30	10	10	1973	YES	3	10,000	3,000	
	A300	2/1	2	1976	YES	-	-	-	
	707-420	4	4	1960	YES	16	61,000	21,000	
LUXAIR, LUXEMBOURG	707-320C	1	1	1972	NO	11	34,000	11,800	Ex Aer Lingis
	Caravelle 6	4	4	1970	NO	12			Ex AVA
MAERSK AIR DENMARK	720B	5	4	1972	NO	15	37,000	23,800	Ex NW (1 Lease to Monarch)
MALAYSIA	707-320C	3	3	1972	NO	12	35,000	13,000	Ex Quantas
	737-200	8	8	1972	YES	4	9,000	10,100	
	737-200C/QC	1	1	1975	YES	1	1,000	1,000	
	DC-10-30	0/2	-	-	-	-	-	-	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
MARTINAIR, NETHERLANDS	DC-8-50F	2	2	1968	NO	10	36,000	9,000	Ex OV Nat'l, Seaboard World
	DC-9-30	1	1	1971	YES	5	13,000	7,500	
	DC-9-30F	2	2	1968	YES	8	17,000	9,900	
	DC-10-30CF	2/1	2	1973	YES	3	9,000	2,400	
	SPEY-JR-F28	1	1	1969	YES	7			
MEXICANA	727-100	7	7	1966	YES	10	29,000	35,800	
	727-200	13	13	1970	YES	6	17,000	17,400	
MIDDLE EAST, LEBANON	747-200B	3	3	1975	YES	1	3,000	600	
	720B	16	16	1965	NO	15	41,000	20,900	Ex AA, WA (More WA coming)
	707-320C	3	3	1968	YES	8	20,000	7,900	
MONARCH, G. BRITAIN	720B	4	4	1971	NO	15	42,000	26,300	Ex NW
	BAC-111-500	2	2	1975	NO	8			Lease from mfr. (Ex Court-line)
NEW ZEALAND NATIONAL	737-200	9	9	1968	YES	8	17,000	23,300	2 Ex PSA
NIGERIA	707-320C	2	2	1970	YES	5	14,000	5,000	
	737-200	2	2	1972	YES	4	5,000	6,900	
	SPEY-JR-F28	5/2	5	1972	YES	4			
OLYMPIC, GREECE	747-200B	2	2	1973	YES	3	10,000	1,800	
	720B	7	7	1972	NO	15	38,000	27,000	Ex NW
	707-320B	2	2	1968	YES	8	24,000	6,900	
	707-320C	4	4	1966	YES	10	30,000	9,200	
	727-200	6	6	1968	YES	8	17,000	13,500	
PAKISTAN INTERNATIONAL	720B	5	4	1961	YES	15	38,000	27,500	1 Lease out; 1 Ex WA
	707-320C	6	6	1966	YES	10	41,000	11,800	
	DC-10-30	3/1	3	1974	YES	2	8,000	3,200	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
PHILIPPINE AIRLINES	DC-8-50	3	3	1961	YES	15	59,000	14,800	1 Ex KLM
	DC-8-30	2	2	1970	NO	16	49,000	12,300	Ex KLM
	DC-8-63	2	2	1963	NO	7	27,000	6,800	Lease KLM
	DC-10-30	3	3	1974	NO	2	13,000	3,900	Lease from KLM
	BAC-111-500	8	8	1971	NO	5			
	707-300	3	3	-	NO	16	44,000	17,300	Ex PA May not be operable
QUANTAS, AUSTRALIA	747-200B	11	11	1971	YES	5	18,000	6,600	
	707-320C	11	11	1965	YES	11	33,000	12,200	
ROYAL AIR MAROC, MOROCCO	727-200	4	4	1970	YES	6	14,000	9,900	
	737-200	0/3	-	-	-	-	-	-	
	Caravelle 3	4	4	1960	YES	16			
	707-300	1	1	1971	NO	16	38,000	13,500	Lease from Air France, May be grounded
ROYAL BRUNEI	737-200	1/1	1	1975	YES	1	-	-	
ROYAL NAPAL	727-100	1	1	1972	YES	4	7,000	4,600	
SABENA, BELGIUM	747-100	2	2	1970	YES	6	20,000	3,900	
	707-320C	6	6	1965	YES	11	37,000	9,300	
	727-100QC	3	3	1967	YES	9	17,000	15,700	
	737-200	11	11	1974	YES	2	6,000	5,700	
	737-200X/QC	4	4	1975	YES	1	3,000	3,200	
	707-320	6	6	1959	YES	17	54,000	14,500	
	DC-10-30CF	3	3	1973	YES	3	10,000	3,100	
	Caravelle 6	4	4	1961	YES	15			
SAHSA, HONDURAS	737-200	1	1	1974	YES	2	5,000	6,900	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
SAS, SCANDINAVIA	747-200B	2	2	1971	YES	5	21,000	4,500	
	DC-8-50	2	2	1965	YES	11	43,000	10,800	
	DC-8-62	5	5	1967	YES	9	34,000	8,500	
	DC-8-62F	3	3	1968	YES	8	33,000	8,300	
	DC-8-63	5	4	1968	YES	8	31,000	7,800	1 Leased to Thai Airways
	DC-9-20	10	9	1968	YES	8	16,000	24,000	1 grounded
	DC-9-30F	2	2	1969	YES	7	15,000	14,900	
	DC-9-40	37/2	37	1968	YES	8	20,000	21,000	
	DC-10-30	4/1	4	1974	YES	2	6,000	2,000	
	Caravelle 3	13	3	1960	YES	16			10 Out of service
SATA, SWITZERLAND	DC-8-63F	1	1	1974	NO	8	23,000	5,800	Ex Flying Tigers
	Caravelle 10R	4	4	1970	YES	6			
SAUDIA	720B	3	3	1961	YES	15	50,000	35,100	
	Caravelle 10R	9	9	1968	YES	8	48,000	11,400	1 Ex World; 1 Lease from Ethiopian
	737-200	5	5	1972	YES	4	12,000	11,400	
	737-200C/QC	2	2	1972	YES	4	11,000	11,100	
	L01011	4	4	1975	YES	1	2,000	1,000	2 Ex TWA
SCANAIR, SWEDEN	727-100	2	2	1967	YES	9	29,000	11,900	
	727-100C/QC	1	1	1968	YES	8	27,000	11,200	
SINGAPORE	747-200B	4/1	4	1973	YES	3	10,000	5,400	
	707-320B	3	3	1968	YES	8	26,000	11,453	
	707-320C	7	7	1971	NO	11	34,000	21,200	Ex BN, CO, Quantas
	737-100	5	5	1969	YES	7	16,000	18,400	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
SOUTH AFRICAN AIRWAYS	747-SP	0/5	-	-	-	-	-	-	
	747-200B	5	5	1971	YES	5	15,000	4,800	
	707-320B	2	2	1965	YES	11	33,000	8,800	
	707-320C	4	4	1968	YES	8	26,000	7,100	
	727-100	6	6	1965	YES	11	23,000	25,000	
	727-100C/QC	3	3	1967	YES	9	18,000	19,100	
	737-200	6	6	1968	YES	8	13,000	17,700	
	707-320	2	2	1960	YES	16	43,000	16,700	
	A300B4	0/4	-	-	-	-	-	-	
SPANTEX, SPAIN	DC-8-61F	2	2	1973	NO	9	28,000	7,000	Lease & Sublease from AA
	DC-9-10	2	2	1974	NO	10	28,000	47,600	Ex Southern
	-23-990A	12	12	1967	NO	15			Ex AA, Modern, Air Trans, Swissair
STERLING, DENMARK	727-200	5	5	1973	YES	3	9,000	3,200	2 Leased from NALS
	Caravelle 10B	5	5	1965	YES	11			
	Caravelle 12	6	6	1971	YES	5			
	Caravelle 6R	11	5	1971	NO	15			Ex UA (5 leased out)
SUDAN	707-320C	2	2	1973	YES	3	6,000	4,700	
	737-200C/QC	2	2	1975	YES	1	1,000	-	
	Comet A11	2	0	1962	YES	14			Grounded
SWISSAIR	747-200B	2	2	1971	YES	5	16,000	3,800	
	DC-8-50	1	1	1963	YES	16	63,000	39,700	Convert from 30
	DC-8-62	5	5	1967	YES	9	37,000	16,700	
	DC-8-62F	2	2	1968	YES	8	32,000	14,400	
	DC-9-30	21	21	1967	YES	9	21,000	25,200	
	DC-9-30F	1	1	1969	YES	7	14,000	13,700	
	DC-9-50	7/3	7	1975	YES	1	2,000	2,000	
	DC-10-30	8	8	1972	YES	4	14,000	4,400	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
SYRIAN ARAB	747-SP	0/2	-	-	-	-	-	-	
	727-200	0/3	-	-	-	-	-	-	
	Caravelle 10B	4	4	1966	YES	10			
	707-420	2	2	1974	NO	16	53,000	19,400	Lease from Brit. Air Tours
TAAG, ANGOLA	737-200C/QC	1	1	1975	YES	1	1,000	-	
TAE, SPAIN	DC-8-20-30	2	2	1973	NO	16	46,000	11,500	Leased from UT
TAN, HONDURAS	737-200	1	1	1974	NO	7	10,000	12,100	Ex Pluna
TAP, PORTUGAL	747-200B	4	4	1972	YES	4	13,000	4,400	
	707-320B	7	7	1966	YES	10	41,000	11,800	
	707-320C	3	3	1973	NO	12	40,000	10,000	2 Ex B. Cal:
	727-100	4	4	1967	YES	9	21,000	16,500	1 Ex World
	727-100C/QC	3	3	1968	YES	8	24,000	16,300	1 Ex Airlift Int'l
	727-200	2	2	1975	YES	1	3,000	3,200	
	Caravelle 6	3	3	1962	YES	14			
TAROM, RUMANIA	707-320C	4	4	1974	YES	2	5,000	2,500	
	BAC-111-400	7	7	1968	YES	8			1 Ex AA
	BAC-111-500	-	-	-	-	-	-	-	Del. 1977
THAI INT'L	DC-8-63	3	3	1974	NO	8	32,000	8,000	Ex SAS)1 leased)
	DC-8-30	6	6	1970	NO	16	54,000	21,600	Ex SAS, Ex Atlantis
	DC-10-30	2	2	1975	NO	3	12,000	3,600	1 leased from UTA; 1 leased from GARUDA
TOA DOMESTIC JAPAN	DC-9-40	14	14	1975	YES	1	3,000	3,000	

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
TRANS-AUSTRALIA	727-100	6	6	1964	YES	12	39,000	29,100	
	727-200	6	6	1972	YES	4	12,000	9,100	
	DC-9-30	12	12	1967	YES	9	24,000	24,000	
TRANSAVIA (HOLLAND)	707-120B	1	1	1972	NO	16	50,000	23,300	Ex AA
	737-200C/QC	3	3	1974	YES	2	7,000	3,800	
	Caravelle 3	3	0	1968	NO				3 grounded
	Caravelle 6R	6	4	1970	NO	15			2 grounded Ex UA
	737-200	2	2	1974	NO		13,000	16,400	
TRANSBRASIL	727-100C/QC	5	5	1974	NO		32,000	34,500	Ex PA
	BAC-111-500	9	9	1970	YES	6			3 Ex Brit, Midland; 2 Ex Courtline
TRANS EUROPA (SPAIN)	Caravelle 10R	3	3	1970	YES	6			1 lease manufacturer; 1 Ex Royal Jord.
	Caravelle 11R	2	2	1969	YES	7			
TRANS EUROPEAN (BELGIUM)	B-720	2	1	1971	NO	14	32,000	15,000	Ex EA, Ex Aer Lingus
	707-120	3	3	1973	NO	17	43,000	21,700	Ex TWA
	A300	2	2	1974	YES	2	1,500	600	
TRANS-MEDITERRANEAN	747-100	2	2	-	NO	-	-	-	Ex AA.
	707-320C	7	7	1970	NO	12	-	-	6 Ex BN; ;Ex AA
TREK SOUTH AFRICA	707-320	1	1	1969	NO	16	45,000	13,900	Ex So Africa
TURKISH AIRLINES	707-100B	4	4	1974	NO	17	42,000	18,900	Lease from PA
	727-200	4	4	1974	YES	2	4,000	3,000	
	DC-9-30	8	8	1968	YES	8			
	DC-10-10	2	2	1972	YES	4	8,000	4,000	
	F-28	3	3	1972	YES	4			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
TUNIS AIR	727-200	5	5	1972	YES	4	11,000	7,600	
	Caravelle 3	5	4	1961	YES	15			
UTA	DC-8-50	1	1	1965	YES	16	50,000	12,500	Convert from 30
(FRANCE)	DC-8-50F	3	3	1965	YES	11	45,000	11,300	
	DC-8-62	3	3	1968	YES	8	33,000	8,300	
	DC-8-63F	2	2	1973	NO	7	22,000	5,500	Ex EA
	Caravelle 10R	1	1	1966	YES	10			
	Caravelle 12	1	1	-	-	-	-	-	
	DC-10-30	4/1	4	1973	YES	3	12,000	4,100	
VARIG AIRLINES (BRAZIL	707-320C	14	14	1965	YES	14	43,000	11,300	2 Ex SB; 1 Ex BN 4 Ex CO; 2 Ex AA
	727-100	7	7	1970	YES	12	24,000	15,800	2 Ex DL
	727-100C/QC	2	2	1973	NO	12	25,000	18,400	1 Ex AL; 1 Ex World
	737-200	10	10	1974	YES	2	3,000	4,300	
	DC-8-20/30	1	0	1965	NO	16	38,000	9,500	Ex PA
	DC-10-30	4	4	1974	YES	2	7,000	1,500	
	707-420	2	2	1960	YES	16	49,000	18,900	
VASP	737-200	19/1	19	1969	YES	7	18,000	17,800	
(BRAZIL)	737-200C/QC	1/1	1	1974	YES	2	10,000	13,600	
VIASA	DC-8-50	2	2	1965	NO	15	56,000	14,000	Leased from KL
(VENEZUELA)	DC-8-63	2	2	1968	YES	8	27,000	6,800	
	DC-8-20/30	1	1	1972	NO	15	55,000	13,800	Ex KLM
	DC-10-30	2	2	1974	NO	2	9,000	3,200	Lease from KLM
YUGOSLAV	707-320C	4	4	1974	NO	12	30,000	11,600	Ex NW
	727-200	5	5	1974	YES	2	4,000	4,000	
	DC-9-30	12	12	1969	YES	6	13,000	13,000	
	Caravelle 6	3	3	1963	YES	13			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY.NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
MODERN	23-990A	6	0	1967	NO				Ex AA, Fleet for sale
AIR GABON	SPEY-JR-F-28	2	2	1975	YES	1			
AIR MALAWI	BAC-111-475	2	2	1972	YES	4			
	VC-10 Std.	1	1	1974	NO				Ex B. Cal.
AIR PACIFIC (FIJI)	BAC-111-475	2							
AREA (ECUADOR)	Comet A11	1							
AUSTRAL (ARGENTINA)	BAC-111-400	4							
	BAC-111-500	4/2							
AVIATECA (GUATEMALA)	BAC-111-500	2	2	1971	YES	5			
	SPEY-JR-F-28	1	1	1974	NO				Lease Transair
BAHAMASAIR	BAC-111-400	3	3	1973	NO				Ex AA
BAVARIA FLUGGESELL-SCHAFT	BAC-111-400	4	4	1967	YES	9			
	BAC-111-500	3	3	1970	YES	6			
BELGIUM INT'L	Caravelle 6	1							
BONAIR (W.GERMANY)	SPEY-JR-F-28	4							
BEA AIRTOURS	Comet A11	9							
CAMBRIAN (U.K.)	BAC-111-400	6							

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
CATAIR (FRANCE)	Caravelle 3	2	2	1971	NO				Ex SAS
	Caravelle 6N	1	1	1974	NO				Ex Sobelair
	Caravelle 6R	2	2	1972	NO				Ex Sterling
	Caravelle 12	1	1	1975	NO				Ex Sterling
CHANNEL AIRWAYS (U.K.)	BAC-111-400	2							
	HS-121-1E	1							
	Comet All	5							
CIMBER AIR (DENMARK)	VFW-614	0/2							
AURALAIR (FRANCE)	Caravelle 6	2	2	1971	NO				Ex Austrian Al
FAR EASTERN (FORMOSA)	Caravelle 6	2	2	1973	NO				Ex Iberia
GERMANAIR	A300B	1	1	1975	YES	1	2,000	1,000	
	BAC-111-500	6	5	1969	YES	7			
GHANA	SPEY-JR-F28	2	2	1974	YES	2			
	VC-10 Std.	1	1	1964	YES	12			
GULF AIR (BAHRANU)	L-1011	0/4	2	1976	YES	1	1,000	600	
	BAC-111-400	4	3	1969	NO				Ex Bahamas, Phil Al
	VC-10 Std.	5	5	1974	NO				Ex BA Overseas Div.
LACSA (COSTA RICA)	BAC-111-500	3	3	1971	YES				
LADE (ARGENTINA)	SPEY-JR-F28	5	5	1974	YES	2			
	Caravelle 6N	3	3	1973	NO				Ex Aerolaru
LINJEFLYG (SWEDEN)	SPEY-JR-F28	3/5	3	1973	YES	3			

AIRLINE	AC TYPE	TTL #	# IN SER	1st YR TYPE OPER	ANY NEW PURCH	AGE HIGH YR	HIGH HOUR	HIGH LAND	REMARKS
NORTHEAST (U.K.) (BKS)	HS-121-1E	4							
ORIENTAIR (G. BRITAIN)	BAC-111-400	1							
QUEBECAIR	BAC-111-300	3	3	1969	NO				Ex British Eagle
	727-100	1	1	1974	NO	14	38,000	31,000	Ex EA
ROYAL AIR LAO	Caravelle 3	1	1	1973	NO				Lease from Air France
SAM(ITALY)	Caravelle 6	4							
TACA INT'L (EL SALVADOR)	BAC-111-400	3	3	1966	YES				
TOURAINE (FRANCE)	SPEY-JR-F28	1/1	1	1974	NO				From mfr.
TRANSAIR LTD. (CANADA)	SPEY-JR-F28	1							
TURAVIA (ITALY)	SPEY-JR-F28	1/1							

Data Source Matrix

Equipment Type	Year of Original Delivery	Total Number	First Year Type Operation	Any Purchased New	High Year	High Hour	High Landings
707,720,727 737,747	A	A	C	A & C	D	E	E
DC-8, DC-9	A	A	A	A	A	E	F
DC-10	A	A	A	A	A	E	E
L-1011	A	A	A	A	A	E	E
Convair 880 & 990	B	C	C	C	D	G	G
A300B	A	A	A	A	D	E	E
Caravelle, Mecure, BAC-111, +15 Trident, VC-10, Comet F28, VFW-614	B	C	B	B	D	G	G

Data Source Key

A. Aircraft manufacture published information.

B. "Commercial Aircraft Fleets" Avmark Inc. (Original deliveries which were not listed distributed by author.)

C. "Commercial Aircraft Fleets" Avmark Inc.

D. Based on year of original delivery either to carrier currently operating or original operator.

E. Manufacture supplied observation extrapolated forward to be representative of mid year 1976.

F. Author estimate based on aircraft flying hours on carrier average hop length for equipment type on general operating characteristics of equipment type.

G. Not estimated because of inadequate data.

APPENDIX C

Sample Interview Questions on Retirement of Commercial Jet Aircraft

1. When do you estimate retirement of specific types and why?

2. What is the limit of use of 707s and DC-8s without further maintenance modification?

3. What necessary work has to be done and how extensive is it to reach (a) 80,000 hrs., (b) 100,000 hrs?

4. Will they be scrapped or sold for other operations?

5. What and where will be the market for used aircraft?

6. What is the economic efficiency of the narrow bodied planes? i.e. are unit DOC costs rising?

7. What is the impact of FAR 36 and the current noise proposal hearings on decisions to retire the older narrow bodies?

8. Do the current fuel costs and your estimation of future fuel cost significantly influence your decision as to retiring aircraft?

9. What is the maximum decrease in direct operating costs that can now be built into new aircraft -- various scenarios?

10. For Airlines: How great a decrease in DOC would be necessary to make you want to purchase a new type or derivative aircraft?

11. What is the capital cost of a fleet reequipment?
    (a) airline views
    (b) manufacturer views

12. What is the effect on reliability of new technology?
    (a) airline view
    (b) manufacturer view

Sample Interview Questions on Retirement of Commercial Jet Aircraft
Page 2

13. On derivative and new aircraft or engine technology, how much "up front" money is necessary and how can it be financed?

14. How can airlines finance replacement aircraft?

15. How many separate new types will be built?

16. What impact do the deregulation proposals in Washington have on your equipment plans?

17. Is there a satisfactory new technology or derivative on the drawing board?

    (a) manufacturer response
    (b) airline response

18. What is the mission of the type of airplane you desire for replacement?

APPENDIX D

INDIVIDUALS INTERVIEWED DURING STUDY

ALLIANCE ONE, STAMFORD, CONNECTICUT

Harry Kimbriel, Vice President

AIR TRANSPORT ASSOCIATION, WASHINGTON, D.C.

William O. Becker, Assistant Vice President-Operations
William M. Hawkins, Assistant Vice President-Economics & Finance
K. William Horn, Assistant Vice President-Research
Lee R. Howard, Director-Data Systems and Forecasting
George W. James, Vice President-Economics & Finance

AMERICAN AIRLINES, TULSA

Leo Cody,
W.P. Hannon, System Director of Engineering

AMERICAN AIRLINES, NEW YORK

Earl E. Ditmars, Assistant Vice President-Traffic Analysis & Research
Richard Klaas, Director-Financial Systems Development & Industry Analysis
Franklin W. Kolk, Vice President-Systems Planning
Richard Linn
Donald Lloyd-Jones, Senior Vice President-Operations
John T. Slavin, Assistant Treasurer

BANK OF AMERICA, NEW YORK

James B. Murray, Assistant Vice President
Sanford Sacks, Vice President

BANKERS TRUST COMPANY, NEW YORK

Jasper H. Arnold, III, Assistant Treasurer
John S. Bliven, First Vice President
Don C. Hawley, Senior Financial Analyst
Robert S. Logan, Assistant Vice President

BOEING COMMERCIAL AIRPLANE COMPANY, SEATTLE, WASHINGTON

George N. Bower, Manager-Advanced Freighters
James L. Copenhaver, Director-Central Engineering Design
Thomas R. Craig-Market Research
Richard A. Michelson, Assistant Director-Sales Technology

BOEING COMMERCIAL AIRPLANE COMPANY, SEATTLE, WASHINGTON

Gene A. Pace, Manager-U.S. & Canadian Airline Analysis Marketing Requirements
Gordon Rasmussen, Manager-Sales Technology
John E. Steiner, Vice President
Robert E. Watson, Chief Engineer-Structures Technology
H.W. "Bob" Withington, Vice President-Engineering

CIVIL AERONAUTICS BOARD, WASHINGTON, D.C.

J.C. Constantz, Chief-Economic Analysis Division
Roy Pulsifer-Bureau of Operating Rights
Arthur Simms, Director-Bureau of Economics

CHASE MANHATTAN BANK, NEW YORK

Harry Colwell, III, Vice President
Raymond V. Nelson, Jr., Vice President

CONTINENTAL ILLINOIS NATIONAL BANK, CHICAGO

Arthur J. Bruen, Vice President-Transportation Division

DELTA AIRLINES, ATLANTA, GEORGIA

Cecil O. Brown, Assistant to Assistant Vice President
Arthur C. Ford, Assistant Vice President-Long Range Planning
Gerald Mayo, Senior Attorney
B.L. Terrell, Chief Engineer-Aircraft

EASTERN AIRLINES, MIAMI, FLORIDA

Frank Davis, Vice President-Operations Services
Morton Ehrlich, Vice President-Planning
D. Roger Ferguson, Vice President-Advance Schedule Planning
Paul Johnstone, Vice President-Engineering
Roy M. Rawls, Asst. Controller, Financial Planning and Analysis
Wayne A. Yeoman, Vice President, Finance

EQUITABLE LIFE INSURANCE, NEW YORK

William A. McCurdy, Vice President

FEDERAL AVIATION ADMINISTRATION, WASHINGTON, D.C.

Joan Reynolds Barriage, Office of Environmental Quality
Charles J. Hoch, P.E. Office of Environmental Quality

FIRST NATIONAL BANK OF CHICAGO

Rodney F. Quainton, Vice President

FIRST NATIONAL CITY BANK, NEW YORK

Barnaby C.F. Blatch, Vice President
Frederick W. Bradley, Vice President
George E. Moyer, Jr., Vice President

GENERAL ELECTRIC, CINCINNATI, OHIO

John D. Karraker, Manager, Commercial Market Analysis
Karl Riter, Commercial Market Analysis

GREYHOUND, PHOENIX, ARIZONA

Robert Dell'Artino, Executive Vice President, Lease and Finance

LOCKHEED CALIFORNIA CO., BURBANK, CALIFORNIA

Richard L. Foss, Department of Engineering, Commercial Advanced Design
Michael I. Grove, Commercial Sales Engineering
Henry W. Montgomery, Airline Planning, Commercial Transportation Research
Walter Nubel, Advanced Design
George N. Sarames, Manager, Airline Systems Analysis
Joseph A. Schwartz, Division Manager, Market Development
Ray A. Tedrick, Market Engineer
O.W. Traber, Product Plans and Applications
William J. Wolff, Division Manager, Technical Sales Support
Duane O. Wood, President

LOCKHEED-GEORGIA CO., MARIETTA, GEORGIA

Jys Ruys, Commercial Market Planning

MC DONNELL-DOUGLAS, LONG BEACH, CALIFORNIA

Edward A. Danner, Deputy Manager, Airline Financial Planning
B. Frome
Sidney J. Griffith, Vice President, Treasurer and Secretary
C.W. Heathco, Deputy Director, Advanced Transportation Concepts
R.C.P. Jackson, Vice President, Plans
R.V. MacGregor
R.A. Margulies, Energy Coordinator
John F. McGrath, Manager, Airline Analysis
R.P. Milton, Manager, Special Planning Analysis
G.R. Morrissey, Senior Economist, Advanced Design, Commercial System
Carl T. Norris, Economist, Economic Research
H.B. Norris, Manager, Airline Fleet Planning

MC DONNELL-DOUGLAS, LONG BEACH, CALIFORNIA (continued)

Bill Richards, Market Research
John A. Stern, Manager, Commercial Research
John W. Stroup, Manager, Commercial Operations Research
Andy Tung
June C. Van Abkoude, Airline Systems Analyst, Advanced Design

MC DONNELL-DOUGLAS, ST. LOUIS, MISSOURI

Kenneth Velten, Section Manager, Commercial Market Analysis

METROPOLITAN LIFE INSURANCE CO., NEW YORK

George M. Crandles, Vice President, Corporate Investments
Stuart R. Kennedy, Vice President

NATIONAL AIRCRAFT LEASING, LOS ANGELES, CALIFORNIA

Eric Anderson

NATIONAL AIRLINES, MIAMI, FLORIDA

Fred Luhm, Fleet Planning
Robert J. Sherer, Controller

NORTHWEST AIRLINES, MINNEAPOLIS, MINNESOTA

Donald W. Nyrop, President

PAN AMERICAN AIRLINES, NEW YORK

Henry P. Hill, Staff Vice President, Schedules
J. Weesner, Vice President, Maintenance Operations
John N. Wolgast, Senior Vice President, Technical Operations

SALOMON BROTHERS, NEW YORK

Julius Maldutis, Vice President, Transportation Group

SHIELDS MODEL ROLAND INC., NEW YORK

Edmund S. Greenslet, CFA, Vice President, Research Division

TRANS WORLD AIRLINES, NEW YORK

Melvin Brenner, Vice President, Marketing and Planning
R.A. Garlin, Manager, Fleet Planning

UNITED AIRLINES, CHICAGO, ILLINOIS

Edward A. Beamish, Senior Vice President, Corporate Planning
Richard M. Brannon, Director of Fleet Planning
Andy M. DeVoursney, Group Vice President, Finance and Planning
Harry Lehr, Director of Regulatory Affairs
Sven E. Madsen, Schedule Research Manager, Schedule and Resource Planning
Colin D. Murray, Vice President, Schedule and Resource Planning
Robert A. Ross, Economist
Irving Roth, Vice President, Investor Relations

UNITED STATES DEPARTMENT OF TRANSPORTATION, WASHINGTON, D.C.

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Lawrence P. Greene, Assistant for Aeronautical Research and Development, Office of the Secretary of Transportation
Dan Maxfield, TPI-12, Transportation Systems Analyst
Wynne Teel, Office of General Council

UNITED STATES HOUSE OF REPRESENTATIVES, WASHINGTON, D.C.

David L. Mahan, Assistant Counsel (Aviation), Committee of Public Works and Transportation

UNITED TECHNOLOGIES, EAST HARTFORD, CONNECTICUT

N. George Avram, Manager, Business Planning
Frank W. Gobetz, Chief, Systems Performance Evaluation
Richard Hoff, Vice President, JT10D Program
Albert A. LeShane, Manager, Systems Evaluation
Richard Mulready, General Manager, JT10D Engine Program
S.M. Taylor, Vice President, Marketing U.S. and Canada

APPENDIX E

FAR 36

36.1 Effective 12/1/69 36.2 Effective 12/1/73

Part 36—Noise Standards: Aircraft Type and Airworthiness Certification

Subpart A—General

§ 36.1 Applicability.

(a) This Part prescribes noise standards for the issue of type certificates, and changes to those certificates, and for the issue of certain standard category airworthiness certificates, for subsonic transport category airplanes, and for subsonic turbojet powered airplanes regardless of category.

(b) Each person who applies under Part 21 of this chapter for a type certificate must show compliance with the applicable requirements of this Part, in addition to the applicable airworthiness requirements of this chapter.

(c) Each person who applies under Part 21 of this chapter for approval of an acoustical change described in § 21.93(b) must show that the airplane meets the following requirements in addition to the applicable airworthiness requirements of this chapter:

(1) The noise limits prescribed in Appendix C of this Part, for airplanes that can achieve those noise levels, or lower noise levels, prior to the change in type design.

(2) The noise levels created by the airplane prior to the change in type design, measured and evaluated as prescribed in Appendixes A and B of this Part, for airplanes that cannot achieve the noise limits prescribed in Appendix C of this Part prior to the change in type design.

(d) Each person who applies for the original issue of Standard Airworthiness Certificates under § 21.183, must, regardless of date of application, show compliance with this Part (including Appendix C), as effective on December 1, 1969, for airplanes that have not had any flight time before—

(1) December 1, 1973, for airplanes with maximum weights greater than 75,000 lbs., except for airplanes that are powered by Pratt and Whitney Turbo Wasp JT3D series engines;

(2) December 31, 1974, for airplanes with maximum weights greater than 75,000 lbs. and that are powered by Pratt and Whitney Turbo Wasp JT3D series engines; and

(3) December 31, 1974, for airplanes with maximum weights of 75,000 lbs. and less.

§ 36.2 Special retroactive requirements.

(a) Notwithstanding § 21.17 of this chapter, and irrespective of the date of application, each applicant covered by § 36.201(b) and (c)(1), and § C36.5(c) of this Part who applies for a new type certificate, must show compliance with the applicable provisions of this Part.

(b) Notwithstanding § 21.101(a) of this chapter, each person who applies for an acoustical change to a type design specified in § 21.93(b) of this chapter must show compliance with the applicable provisions of this Part.

§ 36.3 Compatibility with airworthiness requirements.

It must be shown that the airplane meets the airworthiness regulations constituting the type certification basis of the airplane under all conditions in which compliance with this Part is shown, and that all procedures used in complying with this Part, and all procedures and information for the flight crew developed under this Part, are consistent with the airworthiness regulations constituting the type certification basis of the airplane.

§ 36.5 Limitation of Part.

Pursuant to 49 U.S.C. 1431(b)(4), the noise levels in this Part have been determined to be as low as is economically reasonable, technologically practicable, and appropriate to the type of aircraft to which they apply. No determination is made, under this Part, that these noise levels are or should be acceptable or unacceptable for operation at, into, or out of, any airport.

Subpart B—Noise Measurement and Evaluation

§ 36.101 Noise measurement.

The noise generated by the airplane must be measured under Appendix A of this Part or under an approved equivalent procedure.

§ 36.103 Noise evaluation.

Noise measurement information obtained under § 36.101 must be evaluated under Appendix B of this Part or under an approved equivalent procedure.

Subpart C—Noise Limits

§ 36.201 Noise limits.

(a) Compliance with this section must be shown with noise levels measured and evaluated as prescribed in Subpart B of this Part, and demonstrated at the measuring points prescribed in Appendix C of this Part.

(b) For airplanes that have turbojet engines with bypass ratios of 2 or more and for which—

(1) Application was made before January 1, 1967, it must be shown that the noise levels of the airplane are no greater than those prescribed in Appendix C of this Part, or are reduced to the lowest levels that are economically reasonable, technologically practicable, and appropriate to the particular type design; and

(2) Application was or is made on or after January 1, 1967, it must be shown that the noise levels of the airplane are no greater than those prescribed in Appendix C of this Part.

(c) For airplanes that do not have turbojet engines with bypass ratio of 2 or more and for which—

(1) Application was made before December 1, 1969, it must be shown that the lowest noise levels, reasonably obtainable through the use of procedures and information developed for the flight crew under § 36.1501 are determined; and

(2) Application was or is made on or after December 1, 1969, it must be shown that the noise levels of the airplane are no greater than those prescribed in Appendix C of this Part.

(d) For aircraft to which paragraph (b)(1) of this section applies and that do not meet Appendix C of this Part, a time period will be placed on the type certificate. The type certificate will specify that, upon the expiration of this time period, the type certificate will be subject to suspension or modification under Section 611 of the Federal Aviation Act of 1958 (49 U.S.C. 1431) unless the type design of aircraft produced under that type certificate on and after the expiration date is modified to show compliance with Appendix C. With respect to any possible suspensions or modifications under this paragraph, the certificate holder shall have the same notice and appeal rights as are contained in Section 609 of the Federal Aviation Act of 1958 (49 U.S.C. 1429).

Subpart G—Operating Information and Airplane Flight Manual

§ 36.1501 Procedures and other information.

All procedures, any other information for the flight crew, that are employed for obtaining the noise reductions prescribed in this Part must be developed. This must include noise levels achieved during type certification.

§ 36.1581 Airplane Flight Manual.

(a) The approved portion of the Airplane Flight Manual must contain procedures and

other information approved under § 36.1501. Except as provided in paragraph (b) of this section, no operating limitations may be furnished under this section. The following statement must be furnished near the listed noise levels:

"No determination has been made by the Federal Aviation Administration that the noise levels in this manual are or should be acceptable or unacceptable for operation at, into, or out of, any airport."

(b) If the weight used in meeting the takeoff or landing noise requirements of this Part is less than the maximum weight or design landing weight, respectively, established under the applicable airworthiness requirements, those lesser weights must be furnished, as operating limitations, in the operating limitations section of the Airplane Flight Manual.

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Appendix C

Noise Levels for Subsonic Transport Category and Turbojet Powered Airplanes Under Section 36.201

§ C36.1 Noise measurement and evaluation. Compliance with this Appendix must be shown with noise levels measured and evaluated as prescribed, respectively, by Appendix A and Appendix B of this Part, or under approved equivalent procedures.

§ C36.3 Noise measuring points. Compliance with the noise level standards of § C36.5 must be shown—

(a) For takeoff, at a point 3.5 nautical miles from the start of the takeoff roll on the extended centerline of the runway;

(b) For approach, at a point 1 nautical mile from the threshold on the extended centerline of the runway; and

(c) For the sideline, at the point, on a line parallel to and 0.25 nautical miles from the extended centerline of the runway, where the noise level after liftoff is greatest, except that, for airplanes powered by more than three turbojet engines, this distance must be 0.35 nautical miles.

§ C36.5 Noise levels.

(a) *General.* Except as provided in paragraphs (b) and (c) of this section, it must be shown by flight test that the noise levels of the airplane, at the measuring points described in § C36.3, do not exceed the following (with appropriate interpolation between weights);

(1) For approach and sideline, 108 EPNdB for maximum weights of 600,000 lbs. or more, less 2 EPNdB per halving of the 600,000 lbs. maximum weight down to 102 EPNdB for maximum weights of 75,000 lbs. and under.

(2) For takeoff, 108 EPNdB for maximum weights of 600,000 lbs. or more, less 5 EPNdB per halving of the 600,000 lb. maximum weight down to 93 EPNdB for maximum weights of 75,000 lbs. and under.

(b) *Tradeoff.* The noise levels in paragraph (a) may be exceeded at one or two of the measuring points prescribed in § C36.3, if—

(1) The sum of the exceedance is not greater than 3 EPNdB;

(2) No exceedance is greater than 2 EPNdB; and

(3) The exceedances are completely offset by reductions at other required measuring points.

(c) *Prior applications.* For applications made before December 1, 1969, for airplanes powered by more than three turbojet engines with bypass ratios of two or more, the value prescribed in paragraph (b)(1) of this section may not exceed 5 EPNdB and the value prescribed in paragraph (b)(2) of this section may not exceed 3 EPNdB.

§ C36.7 Takeoff test conditions.

(a) This section applies to all takeoffs conducted in showing compliance with this Part.

(b) Takeoff power or thrust must be used from the start of the takeoff to the point at which an altitude of at least 1,000 feet above the runway is reached, except that, for airplanes powered by more than three turbojet engines, this altitude must not be less than 700 feet.

(c) Upon reaching the altitude specified in paragraph (b) of this section, the power or thrust may not be reduced below that power

or thrust that will provide level flight with one engine inoperative, or below that power or thrust that will maintain a climb gradient of at least 4 percent, whichever power or thrust is greater.

(d) A speed of at least V_2+10 knots must be attained as soon as practicable after liftoff, and must be maintained throughout the takeoff noise test.

(e) A constant takeoff configuration, selected by the applicant, must be maintained throughout the takeoff noise test, except that the landing gear may be retracted.

§ C36.9 Approach test conditions.

(a) This section applies to all approaches conducted in showing compliance with this Part.

(b) The airplane's configuration must be that used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane. If more than one configuration is used in showing compliance with the landing requirements in the airworthiness regulations constituting the type certification basis of the airplane, the configuration that is most critical from a noise standpoint must be used.

(c) The approaches must be conducted with a steady glide angle of $3°\pm0.5°$ and must be continued to a normal touchdown with no airframe configuration change.

(d) A steady approach speed of not less than 1.30 V_S+10 knots must be established and maintained over the approach measuring point.

(e) All engines must be operating at approximately the same power or thrust.

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